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Bird Ingestion into Large Turbofan Engines

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May 1992

Interim Report

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*(Princeton University and Pennsylvania State University)

16. Abstract

The Federal Aviation Administration (FAA) is conducting a study of bird ingestion into certain modern, large high bypass turbofan engines. The engines under consideration were certificated to current FAA standards and are installed in A300, A310, A320, B747, B757, B767, DC10, and MD11 aircraft in commercial service worldwide. Data were collected during 1989-1991 by the principal manufacturers of such engines. This interim report provides some analysis of the initial 381 aircraft ingestion events, with emphasis on the kinds and numbers of ingested birds and the adverse effects of bird ingestion on aircraft engines and flights.

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EXECUTIVE SUMMARY

During 1981-83, the Federal Aviation Administration (FAA) conducted a study of bird ingestions into large high bypass ratio (HBPR) turbofan engines [1]. The majority of such engines in service at that time were certificated under airworthiness standards for bird ingestion pre-dating Change 1 (October 1974) to Part 33 of the Federal Aviation Regulations. Over the past decade many newer HBPR engines, that were designed and certificated to more stringent standards, have come into wide-spread service. The current study grew out of a need to ascertain any changes that have occurred in the bird threat and to assess the effects of bird ingestions on these newer engines.

The data in this interim report, which represent approximately 65 percent of the total amount expected for the study, were generated from over 2 million operations flown by a fleet of more than 1100 aircraft during the period January 1989 to September 1990. Aircraft models include the A300, A310, A320, B747, B757, B767, and DC10.

A total of 381 aircraft ingestions was reported, yielding a worldwide ingestion rate of 1.85 ingestions per 10,000 aircraft operations. This is approximately 80 percent of the rate in the 1981-83 FAA study. The foreign aircraft ingestion rate is currently more than four times the United States rate, compared with two and one-half times in the previous study.

Aircraft ingestion events were reported to have occurred at 120 different airports worldwide. One airport had 10 events and two others had 7 each. All three of these airports are outside the United States. The largest number of events at any United States airport was 4.

There were 16 multiple engine events, yielding a rate slightly under 8 per million operations. Each involved two engines of the aircraft. Thirty-five (35) of the 397 engine ingestions are known to have involved multiple birds.

The species of ingested birds are consistent with the 1981-83 study. The herring gull, common lapwing, black-headed gull, and common rock dove were the most frequently identified ingested bird species. The first three were also the most frequently encountered birds during multiple engine or multiple bird ingestions.

Bird weights, both United States and foreign, are arkedly similar to those in the previous study. This is true not only in terms of summary statistics (median, mode, mean, etc.) but also in terms of the distribution functions for the weights. As before, birds ingested in the United States tend to be heavier than foreign birds.

Forty-seven (47) percent of engines that ingested birds had some reported damage, compared to 62 percent in previous study. Fifty-four (54) percent of current engine damage was classified as "minor," which typically consisted of leading edge distortions or at most three bent, dented, or torn fan blades.

The aircraft ingestion events were fairly evenly split between the departure (takeoff or climb) and arrival (descent, approach or landing) phases of flight. However, engines ingesting birds during departures sustained damage at about twice the rate as in arrivals.

An unscheduled crew action (aborted takeoff, air turnback, etc.) was performed in 14 percent of the aircraft events, which is half the rate in the previous study. There were 11 in-flight engine shutdowns (IFSD's), representing less than 3 percent of all engine events. In the previous study, nearly 13 percent of engine events resulted in an IFSD.

Following is a summary of some data from the current and previous FAA studies. Except where noted, all numbers represent worldwide data.

DATA SUMMARY

	Current Study	1981-83 Study
# aircraft	1162 (5/90)	1513 (6/84)
# operations	2,056,676	2,738,320
# aircraft ingestions *	34/333/381	97/484/638
ingestion rate (x 10^-4) *	0.54/2.34/1.85	0.99/2.80/2.33
# multiple engine events	16	25
multiple engine ingestion rate (x 10^-6)	7.78	9.86
# engine ingestions	397	666
# multiple bird engine ingestions	35	65
% multiple bird ingestions	8.8	9.8
# damaging engine ingestions	185	416
% damaging engine ingestions	47	62
median bird weight (oz.) *	28/14/14	32/18/19
modal bird weight (oz.) *	40/14/40	40/24/40
mean bird weight (oz.) *	30/22/23	30/27/27
# crew action a/c evts.	53	129
% crew actions	13.9	28.2
# IFSD eng. evts.	11	85
% IFSD's	2.8	12.8

* US/FOREIGN/WORLDWIDE

1. INTRODUCTION.

1.1 BACKGROUND.

The Federal Aviation Administration (FAA) conducted a study during 1981-83 to determine the numbers, weights and species of birds being ingested into all large high bypass ratio (HBPR) turbofan engines in service worldwide and to document any resultant damage. The purpose of that effort was to provide data in support of possible changes to the airworthiness certification standards for bird ingestion, so they might better reflect actual service experience. The data were collected by the three principal large engine manufacturers, General Electric (GE), Pratt and Whitney (PW), and Rolls Royce (RR), under contract to the FAA. Results from that study were reported in reference 1.

The majority of large HBPR engines in service at that time were certificated under bird ingestion standards pre-dating 1974. Over the past decade, many newer large HBPR engines that were designed and certificated to more stringent standards have come into wide-spread service. The current study grew out of a need to ascertain any changes that have occurred in the bird threat and to assess the effects of bird ingestions on these newer engines.

The abovementioned three engine manufacturers were again contracted by the FAA to provide as much pertinent data as possible on all known bird ingestions into engines that were certificated under standards of 1974 or later. Unfortunately, because of complexities in contractual startups, it was not possible to synchronize the initiation of data collection between all three manufacturers. The RR and PW data reporting started in January 1989, while GE data collection began in July 1989. It is anticipated that each data collection period will last for 26 months. This interim report is based on initial data collected by RR and GE through September 1990 and by PW through August 1990. All International Aero Engine (IAE) and CFM International (CFMI) data are being collected for this study by PW and GE, respectively, and correspond to their reporting periods.

Two additional FAA bird ingestion studies, for medium and small turbine engines, were conducted in recent years. They were reported on in references 2 and 3.

1.2 OBJECTIVE.

The objective of this study is to determine the numbers, species, and weights of birds being ingested into certain modern large HBPR turbine engines during worldwide service and to assess the impact of these ingestions on engines and aircraft operations.

1.3 ORGANIZATION OF REPORT.

The main body of the report is contained in Sections 2 through 5. These sections are ordered so as to deal with relevant topics according to increasing dependency and complexity. The aircraft fleet under study and operations flown by it are discussed in Section 2. Section 3 deals with various kinds of ingestion events and their rates of occurrence. Airports are also discussed. The population of ingested birds is analyzed in Section 4, while Section 5 examines the adverse effects of bird ingestions on aircraft flights and engines. Section 6 contains a summary of results and presents some conclusions.

2. ENGINES, AIRCRAFT, AND OPERATIONS.

The current study involves all aircraft containing certain large high bypass ratio engines that were certificated under the most recent and most stringent airworthiness standards, i.e., those of Change 1 of October 31, 1974, or Change 5 of March 26, 1984, to Part 33 of the Federal Aviation Regulations. Both of these contain a requirement that an engine having inlet area greater than 3900 square inches continue to operate with 75 percent power and under specified conditions of safety upon the ingestion of a flock of eight 1.5 pound birds. Consideration has been given in recent years to include birds heavier than 1.5 pounds in this "medium bird" certification test. All the applicable portions of the current (March 1984) standard relating to bird ingestion are summarized in appendix A.

Table 2.1 lists each of the engine models covered in this study, along with its manufacturer, takeoff thrust(s), bypass ratio(s), fan tip diameter, inlet area and year(s) in which it was certified. All engines except the V2500 and CFM56 have inlet areas larger than 3900 square inches and, thus, require an eight-bird "medium bird" certification test. The CFM56-5 was certified with seven 1.5-pound birds and the V2500-A1 with six.

The above engine models have been installed in the following types of aircraft: B747, B757, B767, DC10, MD11, A300, A310, and A320. The B747 has four engines while the DC10 and MD11 each have three engines. The rest are all two-engine aircraft. All engines are wing-mounted with the exception of a single tail-mounted engine on the DC10 and MD11. Table 2.2 indicates the approximate number of aircraft in service for each aircraft type included in this study, broken down according to engine model. The numbers represent the worldwide aircraft fleet, which is growing steadily, as of May 1990. The total of 1162 aircraft is roughly 75 percent of the fleet size in the 1981-1983 FAA study, reference 1. Note that a relatively small number of DC10's (those equipped with JT9-59A engines) are represented in this study. The MD11, which entered commercial service in December 1990, will be included in the final report for this study.

An "aircraft operation" is simply one complete flight cycle of an airplane. (See Glossary for formal definition.) It was not possible to utilize Official Airline Guide computer tapes to derive operational data as in previous studies [1 and 2] because these tapes do not distinguish between B747, A300 and DC10 aircraft having older engines and those with the newer engine models included in this study. All operational data, including estimates of United States (50 states) and foreign (non-United States) operations, were obtained from the engine manufacturers.

Figure 2.1 charts the number of monthly worldwide aircraft operations for the entire fleet of aircraft under consideration. These numbers correspond to the data contributed for this report by each engine manufacturer, i.e., there are no operational data from GE for the period January 1 through June 30, 1989 (months 1 through 6) or from PW for September 1990 (month 21). These facts, along with a steady growth in the aircraft fleet over the reporting period, account for the large variation in monthly totals. In the figure, the number of operations for any given month is cumulative. For example, RR reported approximately 20,000 operations with aircraft included in this study during month 16 (April, 1990) while PW and GE each had about 50,000 operations.

TABLE 2.1. ENGINE MODELS

ENGINE MODEL	MANUF.	TAKEOFF THRUST (1000 LB)	BYPASS RATIO	FAN DIAM (IN.)	INLET DIAM (IN.)	YEAR(S) CERTIFIED
JT9D-7Q	PW	53-56	5.2	97.0	83.1	1979
JT9D-59A		53	4.9	97.0	83.6	1974
JT9D-70A		53	4.9	97.0	83.6	1974
JT9D-7R4		48-56	4.8-5	97.0	83.1	1980-82
PW2000		37-41	6.0	78.5	74.5	1983
PW4000		52-60	4.9	93.4	84.0	1986
CF6-80A	GE	48	4.7	86.4	82.8	1981
CF6-80C2		52-60	5.1	93.1	86.2	1985
RB211-535C	RR	37.4	4.4	73.2	73.9	1982
RB211-535E4		40-43	4.1	74.1	74.5	1983
RB211-524G		58	4.3	86.3	86.3	1988
RB211-524H		60.6	4.1	86.3	86.3	1989
V2500-A1	IAE	25	5.4	63.0	59.4	1988
CFM56-5	CFMI	25	6.0	68.3	62.6	1987

TABLE 2.2. AIRCRAFT FLEET

MANUF.	ENG.MODEL	A300	A310	A320	B747	B757	B767	DC10	MD11	TOTALS
PW	JT9D-7Q				86					86
	JT9D-59A	24						17		41
	JT9D-70A				12					12
	JT9D-7R4	19	38		64		92			213
	PW2000					126				126
	PW4000	9	20		21		23		0	73
GE	CF6-80A		47				110			157
	CF6-80C2	48	66		34		74		0	222
RR	RB211-535C					38				38
	RB211-535E4					76				76
	RB211-524G				24					24
	RB211-524H						6			6
IAE	V2500-A1			24						24
CFMI	CFM56-5			64						64
	TOTALS	100	171	88	241	240	305	17	0	1162

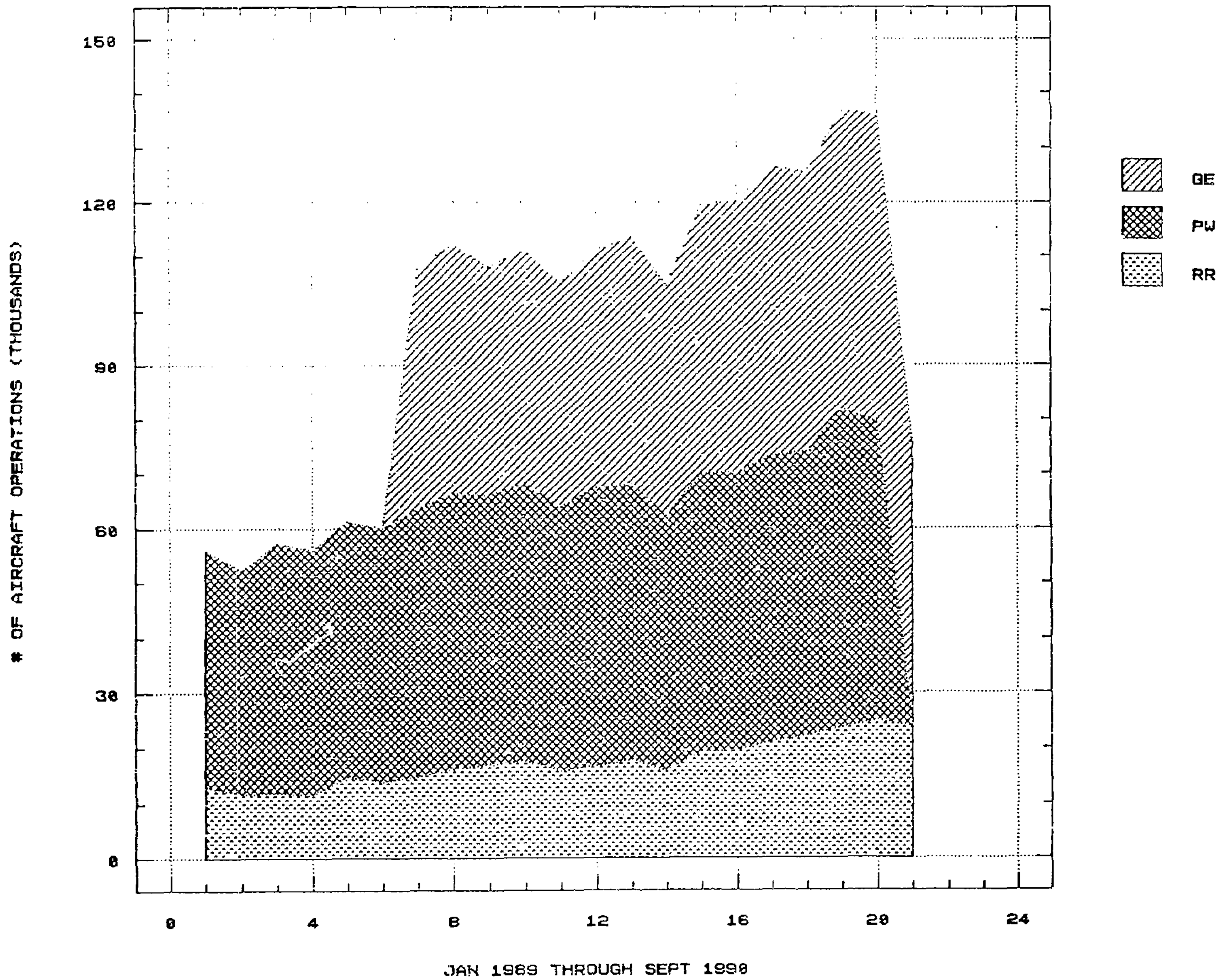


FIGURE 2.1. MONTHLY AIRCRAFT OPERATIONS BY ENGINE MANUFACTURER

As noted in the Introduction, the IAE and CFMI operational data were collected by PW and GE, respectively, and correspond to their reporting periods.

Figure 2.2 indicates the total number of worldwide aircraft operations for each aircraft type, broken down by United States and foreign categories. As in the previous figure, these numbers correspond to the reporting periods of each engine manufacturer. The B757 and B767 flew the largest number of both domestic and worldwide operations. The five remaining aircraft types operated in a predominantly foreign environment. Overall, about 70 percent of the total fleet's operations were foreign. The precise numbers used to generate figure 2.2 can be found in table 3.1. Although worldwide operational data are believed to be fairly accurate, the breakdowns according to United States and foreign stemmed, in some cases, from educated guesses by the engine manufacturers and should be viewed as approximations.

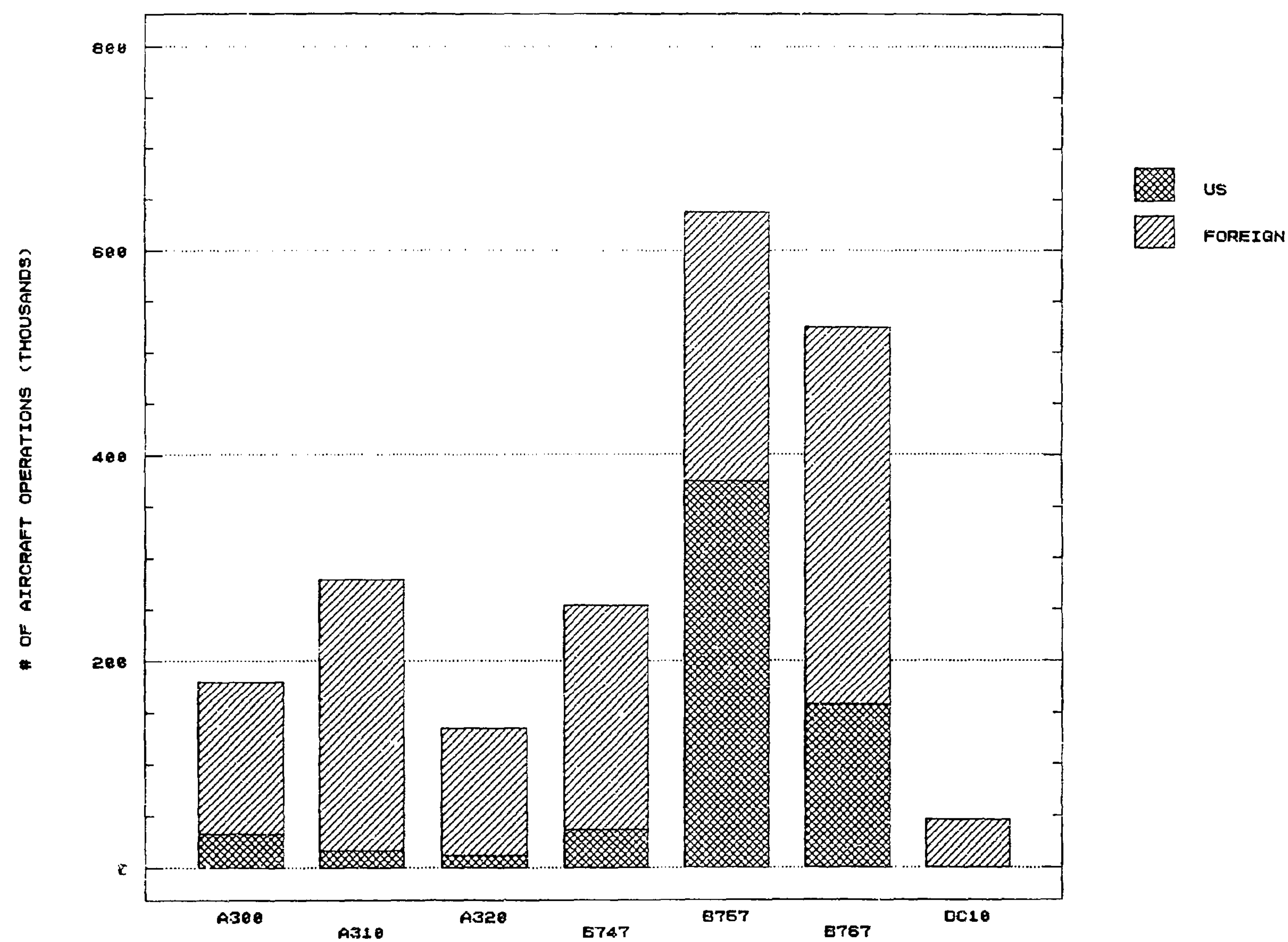


FIGURE 2.2. AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, US/FOREIGN

3. INGESTION EVENTS AND RATES.

In this section various types of bird ingestion events are defined and their frequencies of occurrence are discussed. Although the current study attempts to document all incidents of bird ingestions into the requisite engines, it is likely that many such occurrences remain undiscovered or go unreported. It should be emphasized that only "reported" bird ingestions can be discussed here.

An "aircraft ingestion event" (usually abbreviated as "aircraft ingestion" or "aircraft event") occurs when one or more birds are simultaneously ingested into one or more engines of an aircraft during an aircraft operation. (See Glossary for formal definition.)

Three hundred and eighty-one (381) aircraft events are reported on herein. One of these was a foreign event in which the aircraft type is unknown. Figure 3.1 depicts the aircraft type for the remaining 380 events and indicates whether they occurred inside or outside the United States. This latter information is unknown for 14 of the events. Of those remaining, only 34 occurred in the United States while 333 were foreign. There were no reported United States ingestions for the A300 aircraft and only one for the A310. (The DC10 also had no United States ingestions since it flew no United States operations configured with JT9D-59A engines.) There appears to be a disproportionately small number of United States ingestion events.

It is more meaningful, however, to consider the number of ingestions relative to the frequency of exposure. An "ingestion rate" is obtained by dividing a quantity of ingestion events by the corresponding number of operations. Figure 3.2 is a histogram of reported aircraft ingestion rates for each aircraft type, broken down by United States, foreign, and worldwide categories. As is customary, these rates are expressed in units of ingestions per 10,000 aircraft operations. Only the A320 and B747 had reported United States ingestion rates greater than two, with the latter's actually being more than its foreign counterpart. The A300, A310, B757, and B767 all had substantially higher foreign ingestion rates than domestic. Surprisingly, the only four-engine aircraft (B747) had a lower worldwide ingestion rate than four other aircraft types.

Table 3.1 summarizes aircraft ingestions, operations, and ingestion rates according to aircraft type and United States/foreign/worldwide. The numbers therein were used to generate figures 2.2, 3.1, and 3.2. The reported worldwide ingestion rate for the entire fleet is currently 1.85 (per 10,000 operations), compared to 2.33 in 1981-83 [1]. The current foreign rate, 2.34, is more than four times the domestic rate of 0.54. In the 1981-83 study [1], the foreign rate was approximately 2.5 times the domestic rate. Two possible explanations for this disparity are that (1) bird control measures have been relatively more effective over the past decade at domestic airports than at airports outside the United States, and (2) foreign carriers are presently more diligent than domestic carriers in reporting bird ingestions. It is conceivable that the spate of mergers and bankruptcies among domestic carriers has been a contributing factor to the low United States ingestion rate. For example, one bankrupt major domestic carrier, which has since ceased flying altogether, reported no bird ingestions although it flew a considerable number of operations during the reporting period with aircraft included in this study.

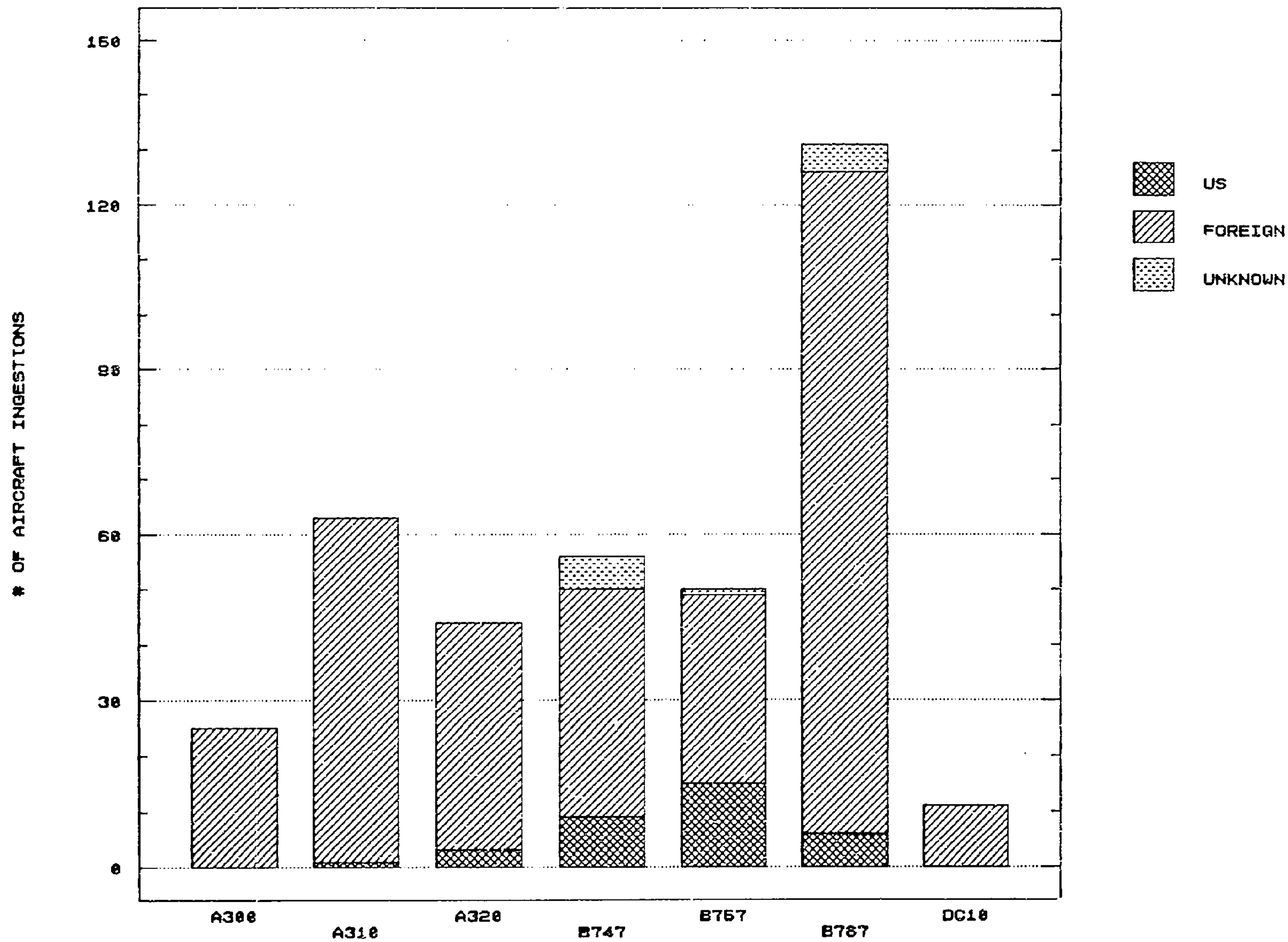


FIGURE 3.1. AIRCRAFT INGESTIONS BY AIRCRAFT TYPE, US/FOREIGN

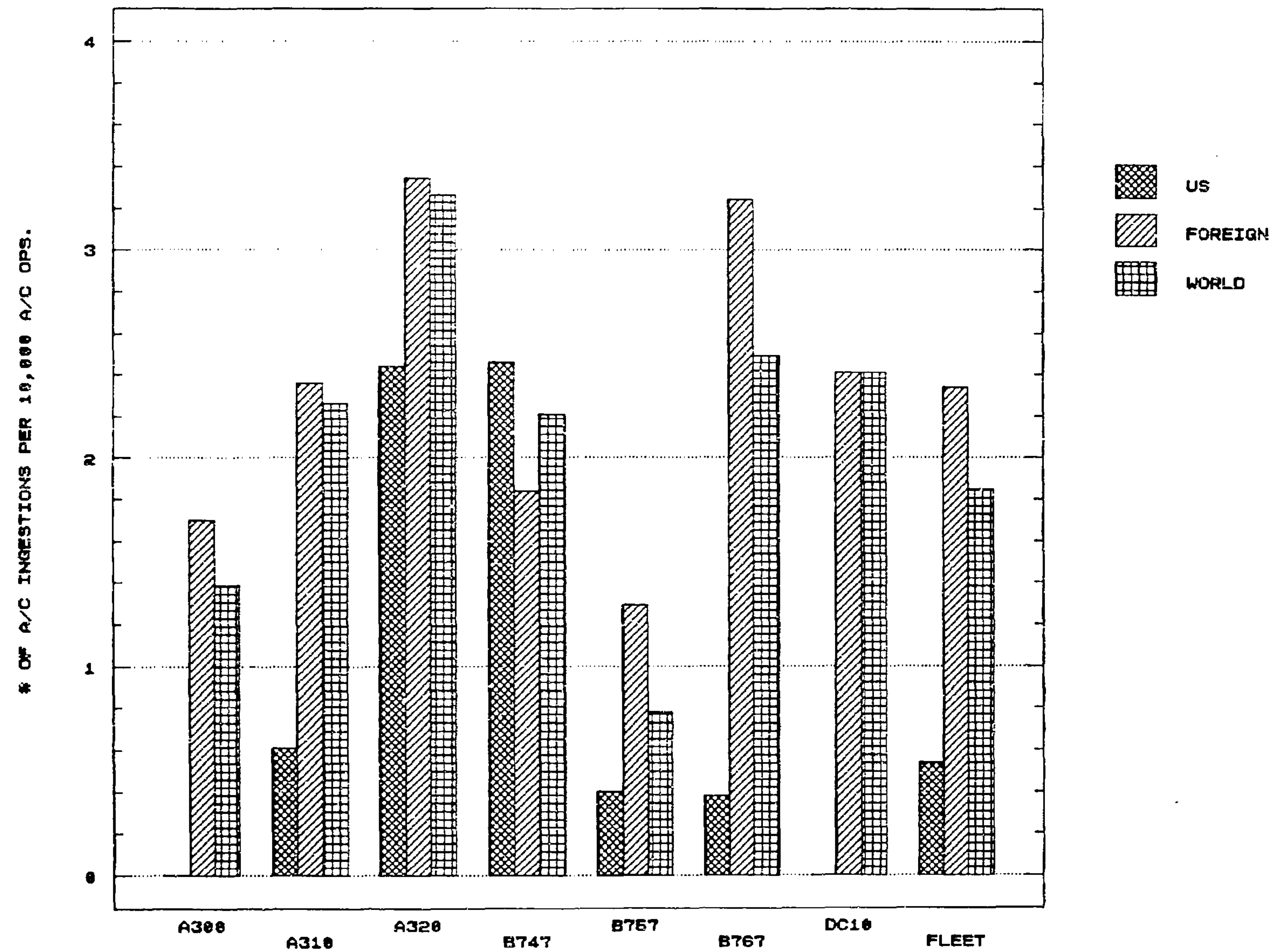


FIGURE 3.2. INGESTION RATES BY AIRCRAFT TYPE, US/FOREIGN/WORLDWIDE

TABLE 3.1. OPERATIONS, INGESTIONS AND INGESTION RATES BY AIRCRAFT TYPE

	AIRCRAFT INGESTIONS				AIRCRAFT OPERATIONS			INGESTION RATES (PER 10,000 OPS.)		
	US	FOR	UNK	WW	US	FOR	WW	US	FOR	WW
A300	0	25	0	25	32,824	147,064	179,888	0.00	1.70	1.39
A310	1	62	0	63	16,333	262,678	279,012	0.61	2.36	2.26
A320	3	41	0	44	12,276	122,633	134,909	2.44	3.34	3.26
B747	9	40	7	56	36,624	217,121	253,745	2.46	1.84	2.21
B757	15	34	1	50	375,117	262,689	637,806	0.40	1.29	0.78
B767	6	119	6	131	158,279	367,366	525,645	0.38	3.24	2.49
DC10	0	11	0	11	0	45,671	45,671	-	2.41	2.41
unk a/c	0	1	0	1						
TOTALS	34	333	14	381	631,453	1,425,222	2,056,676	0.54	2.34	1.85

Because of the staggered start of data collection, any attempt to derive seasonal effects on the bird ingestion phenomenon by simply counting monthly aircraft ingestions could prove misleading. Again, it makes more sense to look at ingestion rates. Figure 3.3 plots reported worldwide ingestion rates by month and year for each of the 21 months of data. In general, the rates are highest from June to October and lowest in December and January. Strictly speaking, this does not show seasonal effects since aircraft operations could not be broken down according to hemisphere. However, only 27 of the 381 aircraft events are known to have occurred in the Southern Hemisphere and the preponderance of aircraft operations were in the Northern Hemisphere.

Some indication of the phase of flight during which an ingestion took place was given for 225 of the 381 aircraft events. Figure 3.4 summarizes these data as reported by the engine manufacturers. All but one event (a cruise) involved a flight phase near an airport. The aircraft ingestions are fairly equally divided between departure (102) and arrival (118) phases. Sixty-two (62) of the former events and 55 of the latter took place on the runway.

In 16 aircraft events, more than one engine of the aircraft ingested a bird, i.e., there were 16 "multiple engine events." All of these involved two engines of the aircraft. Figure 3.5 illustrates, according to aircraft type, both the frequencies and rates of multiple engine ingestion events, worldwide. The rates are given in units of ingestions per million aircraft operations. The aircraft in four of the multiple engine events were B747's while the remaining 12 events involved both engines of two-engine aircraft. The B747 multiple engine ingestion rate is slightly over twice the composite rate for all two-engine aircraft. The current overall fleet multiple ingestion rate of 7.82 is roughly 80 percent of the 9.86 rate in the previous study [1]. Multiple engine ingestion events are of particular interest because they are a prerequisite for the loss of an aircraft due to bird ingestion. They are summarized, along with other types of events to be discussed later in this section, in table 3.2.

Since 397 different engines ingested one or more birds, a total of 397 "engine ingestion events" (usually abbreviated as "engine events" or "engine ingestions") occurred during the reporting period. (See Glossary for formal definition.)

When more than one bird is ingested into an engine, the corresponding aircraft and engine ingestion events are called "multiple bird aircraft events" and "multiple bird engine events," respectively. There were 35 multiple bird engine events. Specific numbers of birds that were ingested in these events are discussed in Section 4. In 29 aircraft events, at least one engine of the aircraft ingested more than one bird; i.e., there were 29 multiple bird aircraft events. Of these, eight were also multiple engine events.

Each multiple engine or multiple bird aircraft event falls into precisely one of the following categories: single engine-multiple bird (SEMB), multiple engine-multiple bird (MEMB), and multiple engine-single bird (MESB). These are all considered to be "significant events." Other events defined to be "significant" in this study are involuntary power loss, transverse fracture of a fan blade, and airworthiness effects. The last category encompasses any flight safety-related incident not covered by the previous categories.

Table 3.2 summarizes, in chronological order, the 42 significant events that were reported. The 16 multiple engine events are seen to be evenly split between

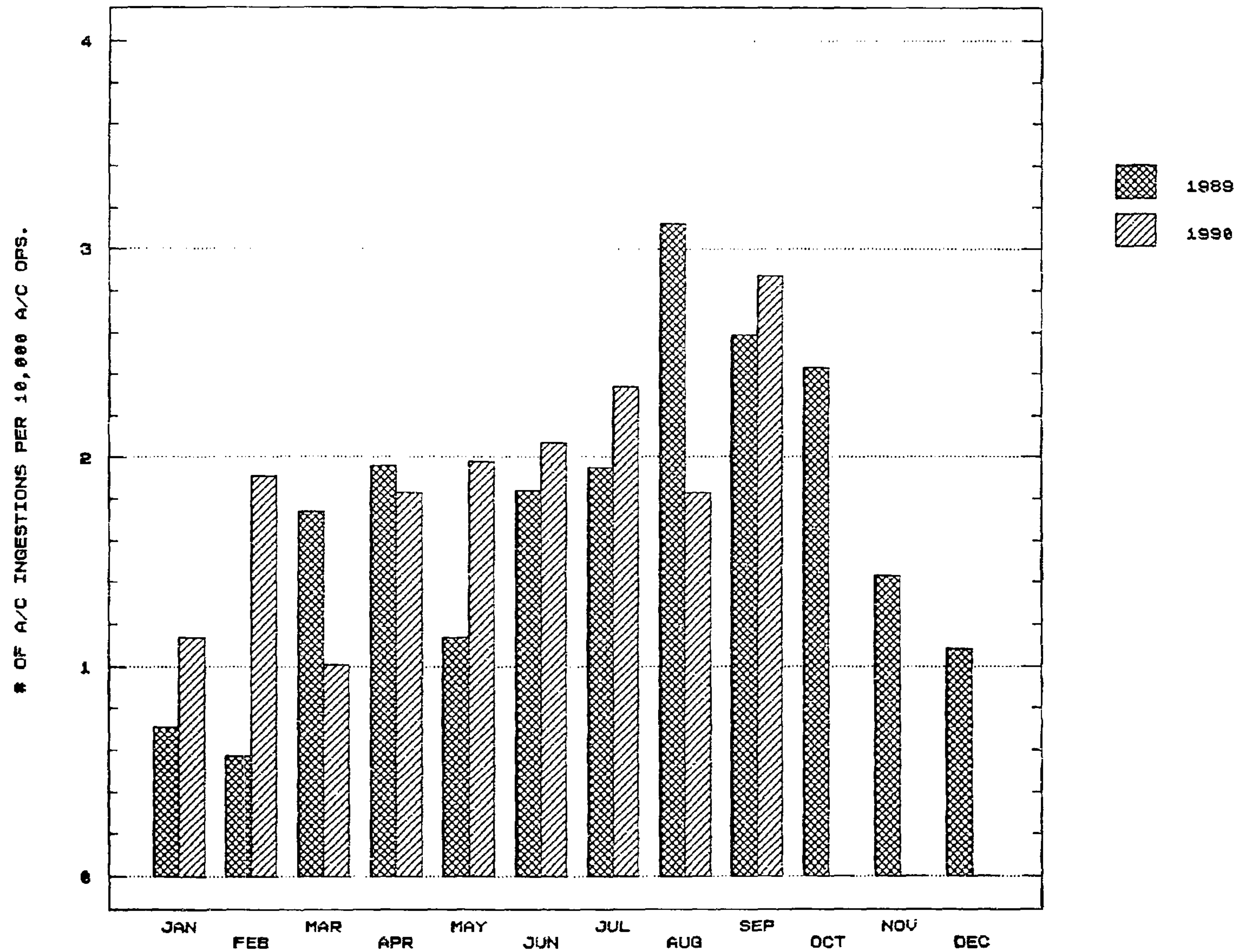


FIGURE 3.3 WORLDWIDE INGESTION RATES BY MONTH AND YEAR

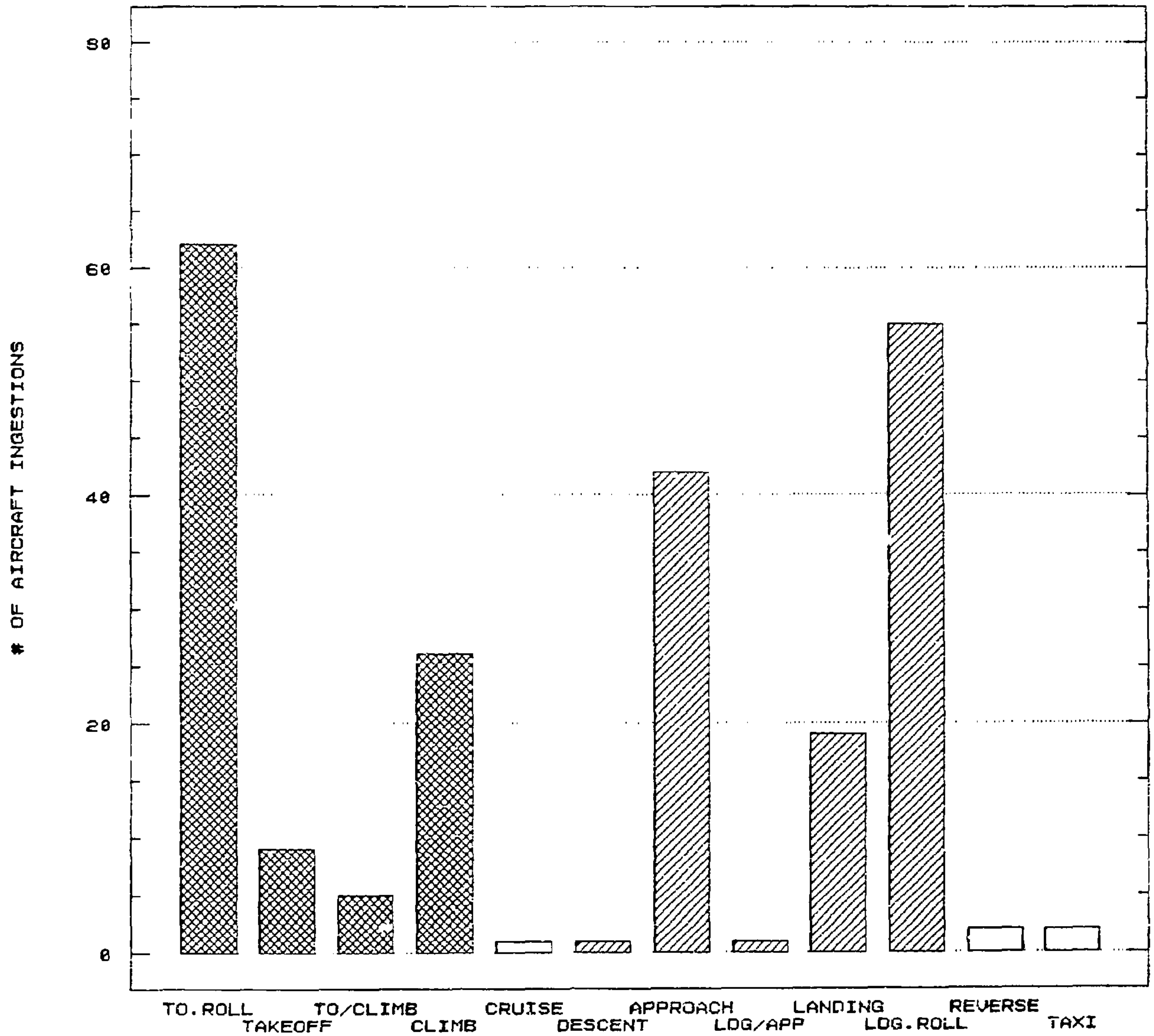


FIGURE 3.4. AIRCRAFT INGESTIONS BY PHASE OF FLIGHT

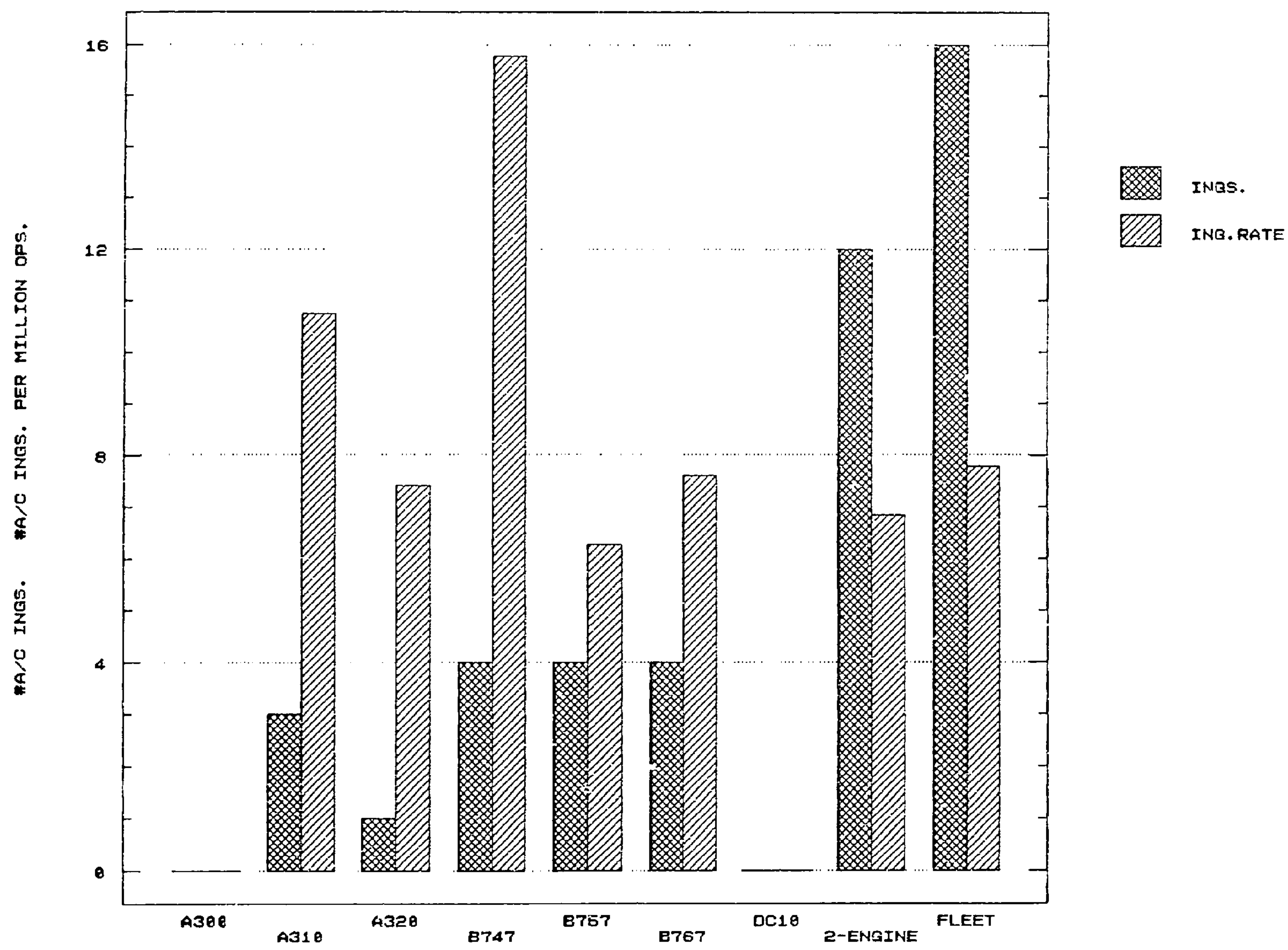


FIGURE 3.5. MULTIPLE ENGINE INGESTIONS AND INGESTION RATES BY AIRCRAFT TYPE

TABLE 3.2. SIGNIFICANT EVENTS

EVT#	DATE	A/C	ENGINE		SIGNIFICANT EVENT	US/FOR	POF
1	01/24/89	B757	RB211	535C	MESB	FOR	TR
16	03/12/89	B747	JT9D	70A	AIRWORTHY	FOR	CL
17	03/13/89	A310	4000	4152	SEMB	FOR	AP
24	04/18/89	B767	JT9D	7R4D	MESB	FOR	
168	05/02/89	B747	JT9D	7R4G2	SEMB		
31	05/04/89	B767	JT9D	7R4D	SEMB	FOR	TR
32	05/10/89	A300	JT9D	59A	SEMB, INVOLUNTARY POWER LOSS	FOR	TR
39	06/18/89	B747	JT9D	7R4G2	AIRWORTHY	FOR	CL
72	07/19/89	B767	CF6	80C2	SEMB	FOR	TR
140	07/25/89	A320	V2500	A1	SEMB	FOR	TR
74	08/13/89	A310	CF6	80C2	SEMB	FOR	TR
75	08/14/89	B767	CF6	80C2	TRANSVERSE FRACTURE	FOR	CL
171	08/31/89	B747	4000	4056	MEMB	US	LR
138	09/12/89	B747	JT9D	7Q	MEMB, TRANSVERSE FRACTURE	US	TR
151	10/04/89	B767	4000	4060	SEMB		
112	10/07/89	B757	RB211	535C	MESB	FOR	LD
150	10/07/89	B767	4000	4060	SEMB	FOR	
152	10/12/89	B767	JT9D	7R4D	MEMB	FOR	TR
155	10/19/89	B767	4000	4060	SEMB	FOR	LR
102	10/21/89	B747	CF6	80C2	MESB	FOR	CL
103	10/23/89	A310	CF6	80C2	SEMB, TRANSVERSE FRACTURE	FOR	TR
158	11/02/89	B767	JT9D	7R4D	SEMB	FOR	AP
115	11/18/89	B757	RB211	535C	SEMB	FOR	LR
85	11/21/89	A320	CFM56	5	MESB	FOR	
97	12/14/89	A310	CF6	80A	MEMB	FOR	LR
116	12/28/89	B757	RB211	535C	SEMB	FOR	TO
184	01/14/90	B767	CF6	80A	SEMB	FOR	LR
219	01/15/90	B767	JT9D	7R4	SEMB	FOR	AP
193	01/16/90	A310	CF6	80C2	MESB	FOR	
244	02/09/90	A310	JT9D	7R4E	MESB	FOR	
226	02/11/90	B747	4000	4056	SEMB		
201	02/21/90	B767	CF6	80C2	MESB	FOR	TR
225	02/21/90	B767	JT9D	7R4D	MEMB	FOR	AP
265	04/06/90	A320	CFM56	5	SEMB	FOR	
292	04/06/90	B767	CF6	80C2	SEMB	FOR	LD
268	05/23/90	A320	CFM56	5	SEMB	FOR	TR
247	05/31/90	A300	JT9D	59A	INVOLUNTARY POWER LOSS	FOR	TR
273	06/14/90	A320	CFM56	5	SEMB	FOR	
214	06/17/90	B757	RB211	535E4	MEMB	US	LD
257	07/30/90	B757	2000	2037	TRANSVERSE FRACTURE	US	CL
323	08/14/90	B757	2000	2037	MEMB	US	TO
382	09/04/90	B747	CF6	80C2	MEMB	FOR	LR

departure and arrival phases of flight. (The acronyms used for phases of flight are defined in appendix C.) Six (6) events are known to have resulted in an involuntary power loss, four of which involved the transverse fracture of a fan blade. All six occurred during departure. In addition there were two "airworthiness" events--one involving extensive cowl damage (event 16) and the other (event 39) resulting in a reduction from the planned flight altitude. Significant events warrant close scrutiny because of their bearing on flight safety and are discussed in further detail in the ensuing sections.

The airport near which the ingestion occurred was able to be identified in 226 (60 percent) of the aircraft events. All told, aircraft ingestions are known to have taken place in the vicinity of 11 domestic and 109 foreign airports during the reporting period. Of the 155 aircraft events in which the associated airport could not be determined, it is known that 14 occurred in the United States and 129 were foreign. Table 3.3 lists all airports at which aircraft ingestions are known to have occurred and tallies the aircraft types involved at each airport. Thirteen of the airports, two of which are in the United States, experienced four or more aircraft ingestions. One of these airports had ten known events and two others each had seven. The airports are organized into eight geographical regions: North America, South America, Europe, Africa, Asia, Australia-New Zealand, Pacific, and Middle East. For this purpose, Japan and Thailand are considered to be in the Pacific region, Korea in Asia, and Cyprus in the Middle East. All remaining airport locations seem to fall naturally into a unique region. XUS (resp. XFO) designates an unknown location known to be in (resp. outside) the United States. XXX indicates a location not known specifically to be domestic or foreign. In two cases, airports designated XXX are known to be in North America.

TABLE 3.3. AIRCRAFT INGESTIONS BY AIRPORT AND AIRCRAFT TYPE

N.AMERICA

AIRPORT	LOCALE	AIRCRAFT A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
ANC	ANCHORAGE,ALASKA				1				1
BOS	BOSTON,MASS.					1			1
DCA	WASHINGTON-NATIONAL,DC					1			1
JFK	NEW YORK-JFK,NY				2	1	1		4
LAX	LOS ANGELES,CAL.				1	1	1		3
MCO	ORLANDO,FLORIDA					1			1
MEM	MEMPHIS,TENN.					1			1
ORD	CHICAGO,ILLINOIS				1	1			2
PAE	EVERETT,WASHINGTON				4				4
PIE	ST.PETERSBURGH,FLA.					1			1
SFO	SAN FRANCISCO,CAL.						1		1
XFO	UNKNOWN,CANADA						1		1
XUS	UNKNOWN,US		1	3		7	3		14
XXX	UNKNOWN,N.AMERICA					1	1		2
YUL	MONTREAL, CANADA			1					1
YVR	VANCOUVER, CANADA		1						1
YYZ	TORONTO, CANADA						2		2
	REGION TOTALS	0	2	4	9	16	10	0	41

S.AMERICA

AIRPORT	LOCALE	AIRCRAFT A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
BUE	BUENOS AIRES,ARGENTINA				1				1
GRU	SAO PAULO,BRAZIL						1		1
IGU	IGUASSA FALLS,BRAZIL						1		1
LIM	LIMA, PERU						1		1
MAO	MANUS,BRAZIL						1		1
	REGION TOTALS	0	0	0	1	0	4	0	5

TABLE 3.3. AIRCRAFT INGESTIONS BY AIRPORT AND AIRCRAFT TYPE (Continued)

EUROPE

AIRPORT	LOCALE	AIRCRAFT A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
AMS	AMSTERDAM,NETHERLANDS		1		5	1	3		10
BCN	BARCELONA,SPAIN	1							1
BEG	BELGRADE,YUGOSLAVIA			1					1
BFS	BELFAST,N.IRELAND,UK					3			3
BRE	BREMEN,GERMANY		1	1					2
BRU	BRUSSELS,BELGIUM		2	1					3
BSL	BASEL,SWITZERLAND			1		1			2
CDG	PARIS-CDG,FRANCE		2	3	1	1			7
CFU	CORFU,GREECE		1						1
CPH	COPENHAGEN,DENMARK						2		2
DUS	DUSSELDORF,GERMANY		1	3					4
FRA	FRANKFURT,GERMANY			2	1				3
GRQ	GRONINGEN,NETHERLANDS						1		1
GVA	GENEVA,SWITZERLAND					2			2
HAM	HAMBURG,GERMANY		1		1	1			3
HER	HERAKLION,GREECE						1		1
IBZ	IBIZIA,SPAIN	1							1
KEV	KEVLAVICK,ICELAND					1			1
LBA	LEEDS-BRADFORD,ENGLAND,UK		1						1
LGW	LONDON-GATWICK,ENGLAND,UK					1	1		2
LHR	LONDON-LHR,ENGLAND,UK			2		2			4
LIL	LILLE,FRANCE			3					3
LJU	LJUBLJANA,YUGOSLAVIA			1					1
LTN	LONDON-LUTON,ENGLAND,UK						1		1
LXS	LEMNOS, GREECE				1				1
LYS	LYON,FRANCE			2					2
MGQ	MISKOLC,HUNGARY		1						1
MUC	MUNICH,GERMANY						3		3
NCE	NICE,FRANCE		1						1
NTE	NANTES,FRANCE		1						1
ORY	PARIS-ORLY,FRANCE			1			1		2
PIK	PRESTWICK,SCOTLAND,UK		1						1
PMI	PALMA,MALLORCA,SPAIN					2			2
SXF	E.BERLIN,GERMANY		2						2
TIV	TIVAT,YUGOSLAVIA			1					1
TLS	TOULOUSE,FRANCE		2	2					4
VCE	VENICE,ITALY					1			1
VIE	VIENNA,AUSTRIA		1						1
WAW	WARSAW,POLAND						2		2
XFO	UNKNOWN,EUROPE			2	1	6			9
ZRH	ZURICH,SWITZERLAND			1					1
	REGION TOTALS	2	19	27	10	22	15	0	95

TABLE 3.3. AIRCRAFT INGESTIONS BY AIRPORT AND AIRCRAFT TYPE (Continued)

PACIFIC

AIRPORT	LOCALE	AIRCRAFT A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
DPS	DENPASAR, BALI	1							1
FUK	FUKUOKA, JAPAN						3	1	4
HIJ	HIROSHIMA, JAPAN						1		1
HND	TOKYO-HND, JAPAN				1		3		4
JKT	JAKARTA, INDONESIA				1				1
KCZ	KOCHI, JAPAN						4		4
KIJ	NIGATA, JAPAN						1		[illegible]
MYJ	MATSUYAMA, JAPAN						2		[illegible]
NGO	NAGOYA, JAPAN						2	1	3
NRT	TOKYO-NRT, JAPAN				1		1		2
OIT	OITA, JAPAN						1		1
OKA	OKINAWA, JAPAN						1	1	2
OKJ	OKAYAMA, JAPAN						3		3
OSA	OSAKA, JAPAN						2		2
PEN	PENANG, MALAYSIA		2						2
SDJ	SENDAI, JAPAN						3		3
SHI	SHIMOJISHIMA, JAPAN						1		1
SIN	SINGAPORE				1				1
SPK	SAPPORO, JAPAN				1		3	1	5
TAK	TAKAMATSU, JAPAN						1		1
TOY	TOYAMA, JAPAN						3		3
TPE	TAIPEI, TAIWAN				1				1
TYO	TOKYO-TYO, JAPAN						3		3
XFO	UNKNOWN, PACIFIC	1			7		3	4	15
	REGION TOTALS	2	2	0	13	0	41	8	66

TABLE 3.3. AIRCRAFT INGESTIONS BY AIRPORT AND AIRCRAFT TYPE (Continued)

ASIA

AIRPORT	LOCALE	A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
BOM	BOMBAY, INDIA	1		1	1				3
CCU	CALCUTTA, INDIA		1						1
DEL	DELHI, INDIA		1	2	1				4
HKG	HONG KONG				1				1
KHI	KARACHI, PAKISTAN	1	1						2
KTM	KATHMANDU, NEPAL					1			1
KUH	KUSHIRO, INDIA						1		1
PAU	PAUK, BURMA			1					1
PEK	BEIJING, CHINA							1	1
SEL	SEOUL, KOREA	1							1
SHA	SHANGHAI, CHINA	1							1
TRV	TRIVANDRUM, INDIA		1						1
XFO	UNKNOWN, ASIA	1				3			4
	REGION TOTALS	5	4	4	3	4	1	1	22

AUSTRALIA-NEW ZEALAND

AIRPORT	LOCALE	A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
AKL	AUCKLAND, NEW ZEALAND						1		1
BNE	BRISBANE, AUSTRALIA		1						1
LST	LAUNCESTON, AUSTRALIA			1					1
PER	PERTH, AUSTRALIA						1		1
RMA	ROMA, AUSTRALIA			1					1
SYD	SYDNEY, AUSTRALIA			1	1				2
WLG	WELLINGTON, NEW ZEALANI						1		1
	REGION TOTALS	0	1	3	1	0	3	0	8

TABLE 3.3. AIRCRAFT INGESTIONS BY AIRPORT AND AIRCRAFT TYPE (Continued)

MIDDLE EAST

AIRPORT	LOCALE	AIRCRAFT A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
AMM	AMMAN, JORDAN		1						1
ANK	ANKARA, TURKEY		1						1
AYT	ANTALYA, TURKEY		1						1
DHA	DHAHRAN, SAUDI ARABIA	1							1
ETH	ELAT, ISRAEL						1		1
IST	ISTANBUL, TURKEY		5		1	1			7
JED	JEDDAH, SAUDI ARABIA	2							2
LCA	LARNACA, CYPRUS		3						3
RUH	RIYADH, SAUDI ARABIA	1							1
SHJ	SHARJAH, UA EMIRATES		1				1		2
TLV	TEL AVIV, ISRAEL					1	2		3
XFO	UNKNOWN, MIDDLE EAST	2							2
	REGION TOTALS	6	12	0	1	2	4	0	25

AFRICA

AIRPORT	LOCALE	AIRCRAFT A300	A310	A320	B747	B757	B767	DC10	AIRPORT TOTALS
BJL	BANJUL, GAMBIA		1						1
EBB	ENTEBBE, UGANDA		1						1
HRE	HARARE, ZIMBABWE						1		1
KRT	KHARTOUM, SUDAN	1							1
MBA	MOMBASA, KENYA		2						2
NBO	NAIROBI, KENYA	1					1		2
WDH	WINDHOEK, NAMIBIA				1				1
	REGION TOTALS	2	4	0	1	0	2	0	9

4. CHARACTERISTICS OF INGESTED BIRDS.

The numbers, species, and weights of birds that were ingested into the engines are discussed in this section. The bird species and weight were determined by licensed ornithologists upon examination of bird remains recovered from the engines. Numbers of birds were estimated by representatives of the engine manufacturers, usually from the locations and patterns of bird debris in the engines.

Table 4.1 summarizes the data concerning numbers of birds ingested. Three hundred and five (305) of the engine ingestions involved only a single bird while 35 were determined to be multiple bird events. Some estimate of the number of birds ingested was obtained in 342 of the 397 engine events. In 19 of these events the exact number could not be determined but rather a minimum and/or maximum number was given. Four or more birds are known to have been ingested six times. Four of these events were foreign and the other two occurred in a B747 multiple engine-multiple bird ingestion of 14-ounce common rock doves at Los Angeles (event 138). (See Section 5.) Estimates of bird numbers were given as "one or more" for two engine ingestions. It therefore remains undetermined whether these events (154 and 159) were single or multiple bird ingestions.

Despite considerable effort by the data collectors, bird remains were recovered in only 119 of the 381 aircraft events. To date, identifications have been made, each yielding a unique species and weight, in 105 of these aircraft events. Sixteen of these are domestic events and 87 are foreign. It could not be determined whether the ingestion took place inside or outside the United States in two events for which a species identification was made. These are event 137 (a 1.5-ounce horned lark) and event 130 (a 10-ounce black-headed gull).

Table 4.2 summarizes the data regarding bird species. The species codes are taken from reference 4. The number of aircraft ingestions (United States, foreign, and worldwide) are tallied for each species known to have been ingested. Since weights for a given species can vary according to sex, maturity, and geographical location, the modal (most common) estimated ingested weight and the range of estimated weights are also given for each species. The table is ordered by modal weight. Also indicated is the number of single engine-multiple bird (SEMB), multiple engine-single bird (MESB) and multiple engine-multiple bird (MEMB) aircraft events in which each species was involved. The common lapwing, black-headed gull, common rock dove and herring gull were the most frequently identified species. Together they account for 31 percent of the aircraft ingestions in which a verified species was obtained. The "multiple events" column indicates that the common lapwing, black-headed gull, and herring gull are also the most pervasive flocking bird species being encountered. The initial two species are "small" birds, having modal weights of 8 and 10 ounces, while the herring gull modal weight is 40 ounces. Two "bat" events of 0.3 and 0.5 ounces are included in the data, the latter being a multiple engine event (24).

All 105 verified bird weights are tabulated in table 4.3. The unique weights are listed in ascending order, and the number of United States, foreign, and worldwide aircraft ingestions are given for each. Summary statistics (as defined in appendix B) are given in table 4.4 for each of these three geographical weight groupings. The mean, median, and mode for domestic weights are each seen to be larger than their foreign counterparts.

TABLE 4.1. NUMBERS OF INGESTED BIRDS

# OF BIRDS	US	FOREIGN	UNKNOWN	WORLDWIDE
1	24	276	5	305
2	0	12	0	12
3	0	4	0	4
4	1	1	0	2
1 OR MORE	0	2	0	2
2 OR MORE	4	6	3	13
5 OR MORE	1	0	0	1
6 TO 17	0	2	0	2
4 TO 5	1	0	0	1
UNKNOWN	7	44	4	55
TOTALS	38	347	12	397

TABLE 4.2. BIRD SPECIES

SPECIES	SPECIES CODE	MODAL WT(OZ.)	WEIGHT RANGE(OZ.)	US	FOR	WW	MULTIPLE EVENTS
LITTLE BROWN BAT	BAT	0.3,0.5	0.3-0.5	0	2	2	1MESB
DON-SMITH'S NIGHTJAR	5T55	1.25		0	1	1	
FORK-TAILED SWIFT	1U70	1.5		0	1	1	
CHIMNEY SWIFT	1U33	1,2	1-2	0	2	2	
COMMON SKYLARK	17Z72	1.5,2	1.5-2	0	2	2	
HORNED LARK	17Z74	1.5,2	1.5-2	0	1	2	1SEMB
AMERICAN ROBIN	41Z314	2.5	2.5	2	0	2	
SCHRENDK'S BITTERN	1I9	3		0	1	1	
WHT-THT'D NDLE-TLD SWIFT	1U?	3		0	1	1	
KILLDEER	5N33	3		0	1	1	
COMMON NIGHT HAWK	5T5	3		1	0	1	
MOURNING DOVE	2P105	4		1	0	1	
AMERICAN KESTREL	5K26	4		1	0	1	
RING-NECKED DOVE	2P61	5		0	1	1	
COMMON SNIPE	6N47	5		0	1	1	
SENEGAL COUCAL	2R127	7		0	1	1	1SEMB
BANDED PLOVER	5N23	7		0	1	1	
COMMON LAPWING	5N1	7.7,8	7.7-8	0	8	8	2SEMB 2MESB
EURASIAN KESTREL	5K27	8	7.2-8	0	4	4	
GREATER KESTREL	5K24	9.6		0	1	1	
BLACK-HEADED GULL	14N36	10	10	0	6	7	2SEMB 2MEMB
GRAY-HEADED LAPWING	5N20	10	10	0	2	2	1SEMB
RED-BILLED GULL	14N?	11		0	1	1	
COMMON BARN OWL	1S2	11	11	0	2	2	
COMMON ROCK DOVE	2P1	14	10	1	7	8	1MEMB
HUNGARIAN PARTRIDGE	4L85	14	14	0	2	2	1SEMB
COMMON SAND MARTIN	18Z29	16		0	1	1	
RED-LEGGED PARTRIDGE	4I41	16		0	1	1	
EURASIAN STONE CURLEW	6N?	16		0	1	1	1SEMB
RING-BILLED GULL	14N12	17	17	1	1	2	
LITTLE EGRET	1I50	17		0	1	1	
CHUKAR	4L37	18	18	0	2	2	1MEMB
CARRION CROW	22Z94	19		0	1	1	
BLACK-TAILED GULL	14N10	21		0	1	1	
BLACK-CROWNED NITE HERON	1I24	24	24	1	2	3	
AFRICAN EAGLE OWL	2S44	26		0	1	1	
BLACK KITE	3K28	28	28-32	0	5	5	
COMMON POCHARD	2J115	35		0	1	1	1SEMB
GREATER SCAUP	2J124	36		0	1	1	1MEMB
HERRING GULL	14N14	40	32-40	3	7	10	2SEMB 1MEMB
MALLARD DUCK	2J84	40		0	1	1	
RING-NECKED PHEASANT	4L161	40	32-40	2	2	4	1MEMB
WESTERN GULL	14N19	40.4		1	0	1	
JAR FALCON	5N??	46.4		0	1	1	
GLAUCOUS-WINGED GULL	14N22	48		0	1	1	
BLACK VULTURE	1K4	48	48	0	2	2	
HELMETED GUINEA FOWL	5L3	52		0	1	1	
OSPREY	2K1	55		1	0	1	
EGYPTIAN VULTURE	3K43	75	75	0	2	2	
AFRICAN FISH EAGLE	3K??	100		0	1	1	
CANADA GOOSE	2J30	128		1	0	1	
INDIAN WHT-BCKD VULTURE	3K46	192		0	1	1	
			TOTALS	16	87	105	

TABLE 4.3. BIRD WEIGHTS BY US/FOREIGN/WORLDWIDE

BIRD WEIGHT	US	FOREIGN	UNKNOWN	WORLDWIDE
0.3		1		1
0.5		1		1
1		1		1
1.25		1		1
1.5		2	1	3
2		3		3
2.5	2			2
3	1	3		4
4	2			2
5		2		2
7		3		3
7.2		1		1
7.7		4		4
8		6		6
9.6		1		1
10		8	1	9
11		3		3
14	1	9		10
16		3		3
17	1	2		3
18		2		2
19		1		1
21		1		1
24	1	2		3
26		1		1
28		3		3
32	1	4		5
34		1		1
35		1		1
36		2		2
40	4	6		10
40.4	1			1
46.4		1		1
48		3		3
52		1		1
55	1			1
75		2		2
100		1		1
128	1			1
192		1		1
TOTALS	16	87	2	105

TABLE 4.4. BIRD WEIGHT SUMMARY STATISTICS - CURRENT STUDY

STATISTIC	US	FOREIGN	WORLDWIDE
SAMPLE SIZE	16	87	105
MEAN	30.4	21.8	22.8
MEDIAN	28	14	14
MODE	40	14	40
STD. DEVIATION	31.4	26.0	26.8
MINIMUM	2.5	0.3	0.3
MAXIMUM	128	192	192
LOWER QUARTILE	4	7.7	7.7
UPPER QUARTILE	40	32	32

TABLE 4.5. BIRD WEIGHT SUMMARY STATISTICS - 1981-83 STUDY

STATISTIC	US	FOREIGN	WORLDWIDE
SAMPLE SIZE	57	185	258
MEAN	29.7	26.6	26.9
MEDIAN	32	18	19
MODE	40	24	40
STD. DEVIATION	21.4	35.4	31.8
MINIMUM	1	1	1
MAXIMUM	112	240	240
LOWER QUARTILE	14	11	11
UPPER QUARTILE	40	28	32

Summary statistics from the 1981-83 study corresponding to those in table 4.4 are given in table 4.5. (Since only verified weights are considered in this report, the numbers in table 4.5 vary somewhat from those in reference 1.) Similarities between bird weights from the two studies are evident upon comparing these tables. The mean, median, and modal weights for all three geographic categories are, in general, within a few ounces of each other. In both studies the United States bird weights are, in terms of these summary statistics, larger than the foreign bird weights.

It should be noted that two additional unverified bird weights, each of 8 ounces, were reported in the current study. They were for events 13 and 265 and were based on visual observation of birds at the ingestion site. Since visual weight estimates are notoriously inaccurate, these weights were not included in the above tables or in any analysis.

For analytical purposes, each bird weight was assigned a weight class as defined in table 4.6. The first class (tiny birds) includes all weights of 3 ounces or less. The remaining weights were grouped into successive 8-ounce intervals as indicated. For example, the 0.5-pound class contains all weights greater than 3 ounces and less than or equal to 11 ounces. This scheme was chosen because it distinguishes between and yields intervals "centered" around 1.5, 2, and 2.5 pounds, weights which are significant in terms of current and proposed certification standards.

The 105 verified bird weights fall into 12 distinct weight classes. Figure 4.1 indicates the frequency of aircraft ingestions of United States, foreign, and unknown origin for each of these weight classes. The vast majority of bird weights fall into the smallest three weight classes (tiny, 0.5 pound, and 1 pound) and relatively few are in the 1.5-pound class. There are, however, a significant number in the 2-pound and 2.5-pound classes. Indeed, the 2.5-pound weight class contains more domestic bird weights (5) than any other class. Four of these events occurred at Kennedy International Airport in New York (68, 98, 263, and 323) and the other (257) at Los Angeles International Airport.

Figure 4.2 plots the cumulative distribution functions (see appendix B) for both United States and foreign bird weights. The two distributions diverge between 10 and 40 ounces, with a larger percentage of foreign bird weights falling into this range. However, apparently because of the sparse number of United States weights, an application of the Kolmogoroff-Smirnov Two-Sample Test (see appendix B) yields P = 24 percent and, thus, fails to show that the domestic and foreign bird weight sample distributions are indeed statistically different at a sufficiently high confidence level. (The corresponding distributions were shown to be different by this two-sample test in the previous FAA large engine study, reference 1.)

It is interesting to make further comparisons between bird weights from the two studies. Plots comparing the United States, foreign, and worldwide cumulative bird weight distributions from both studies are contained in figure 4.3. Similarities between the corresponding distributions are evident. It turns out to be more enlightening, however, to compare relative frequency histograms of weight distributions. This is done in figure 4.4(a) for domestic weights and figure 4.4(b) for foreign. Only the nine weight classes up to 4 pounds, as defined in table 4.5, are included in these figures since ingestions of weights over 4 pounds are very rare. In each case, the similarities are notable. Both

TABLE 4.6. BIRD WEIGHT CLASSES - DEFINITIONS

WEIGHT RANGE(oz.)	WEIGHT CLASS(lbs.)
3 or less	Tiny
3+ to 11	.5
11+ to 19	1
19+ to 27	1.5
27+ to 35	2
35+ to 43	2.5
43+ to 51	3
51+ to 59	3.5
59+ to 67	4
67+ to 75	4.5
75+ to 83	5
83+ to 91	5.5
91+ to 99	6
99+ to 107	6.5
107+ to 115	7
115+ to 123	7.5
123+ to 131	8
131+ to 139	8.5
139+ to 147	9
147+ to 155	9.5
155+ to 163	10
163+ to 171	10.5
171+ to 179	11
179+ to 187	11.5
187+ to 195	12

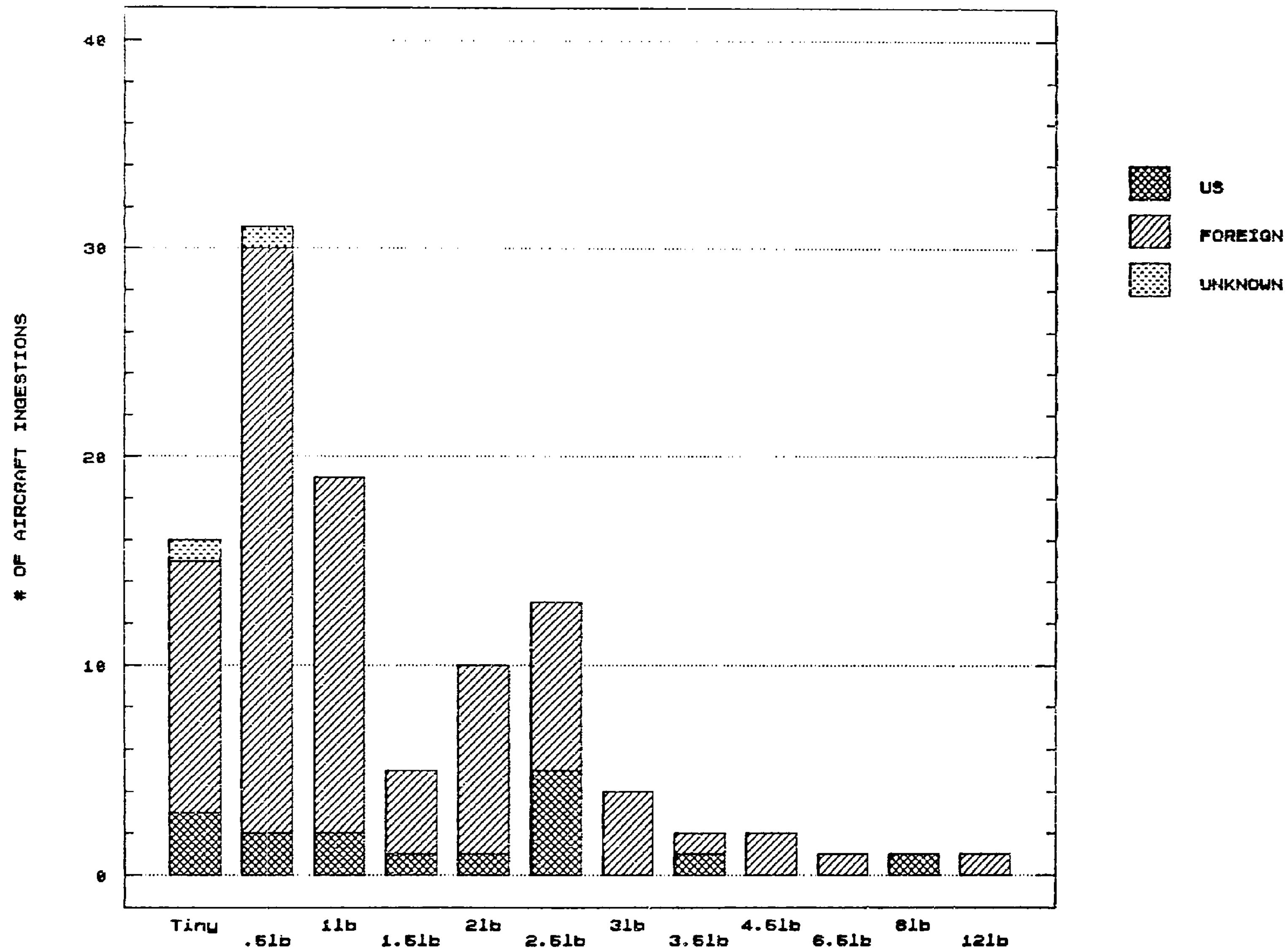


FIGURE 4.1. AIRCRAFT INGESTIONS BY BIRD WEIGHT CLASS, US/FOREIGN

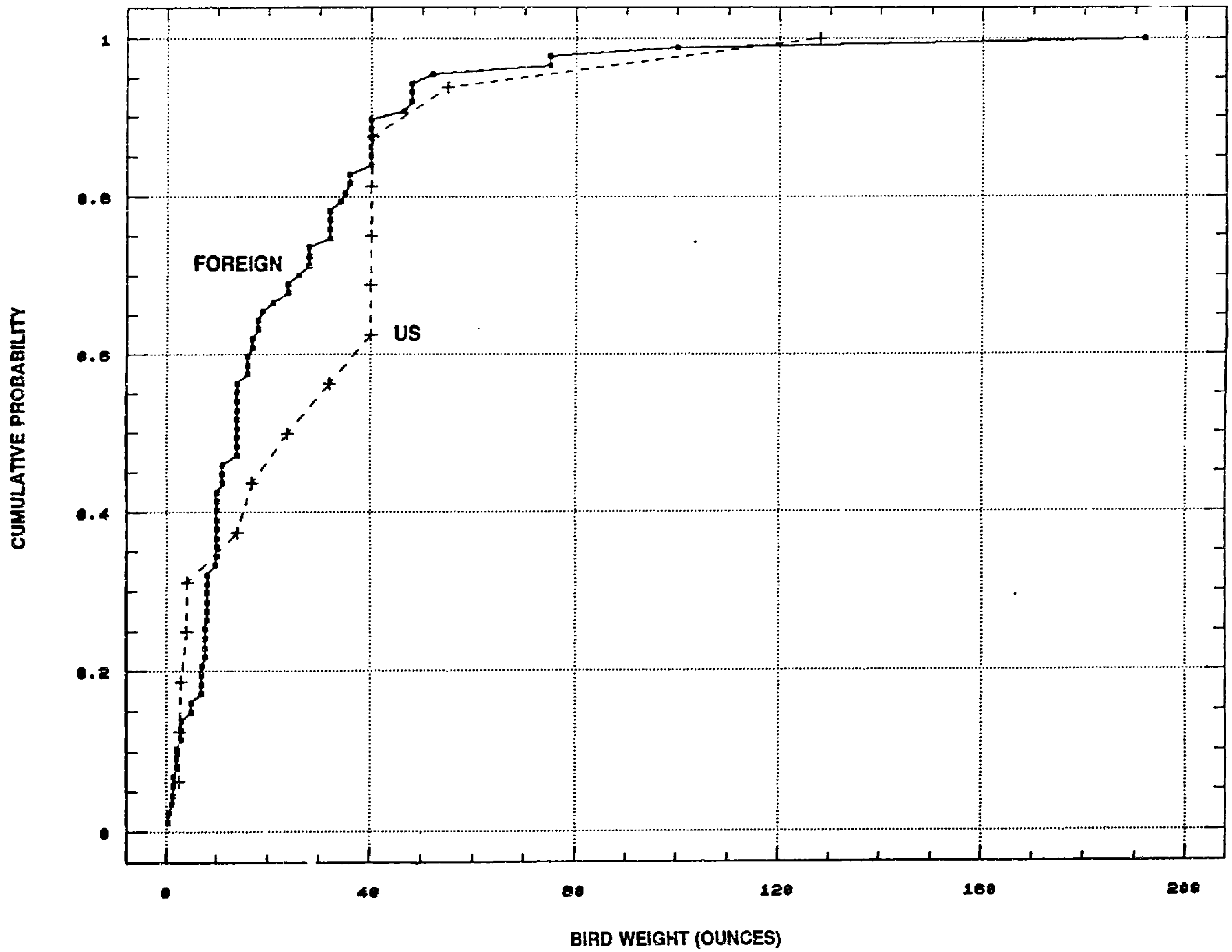
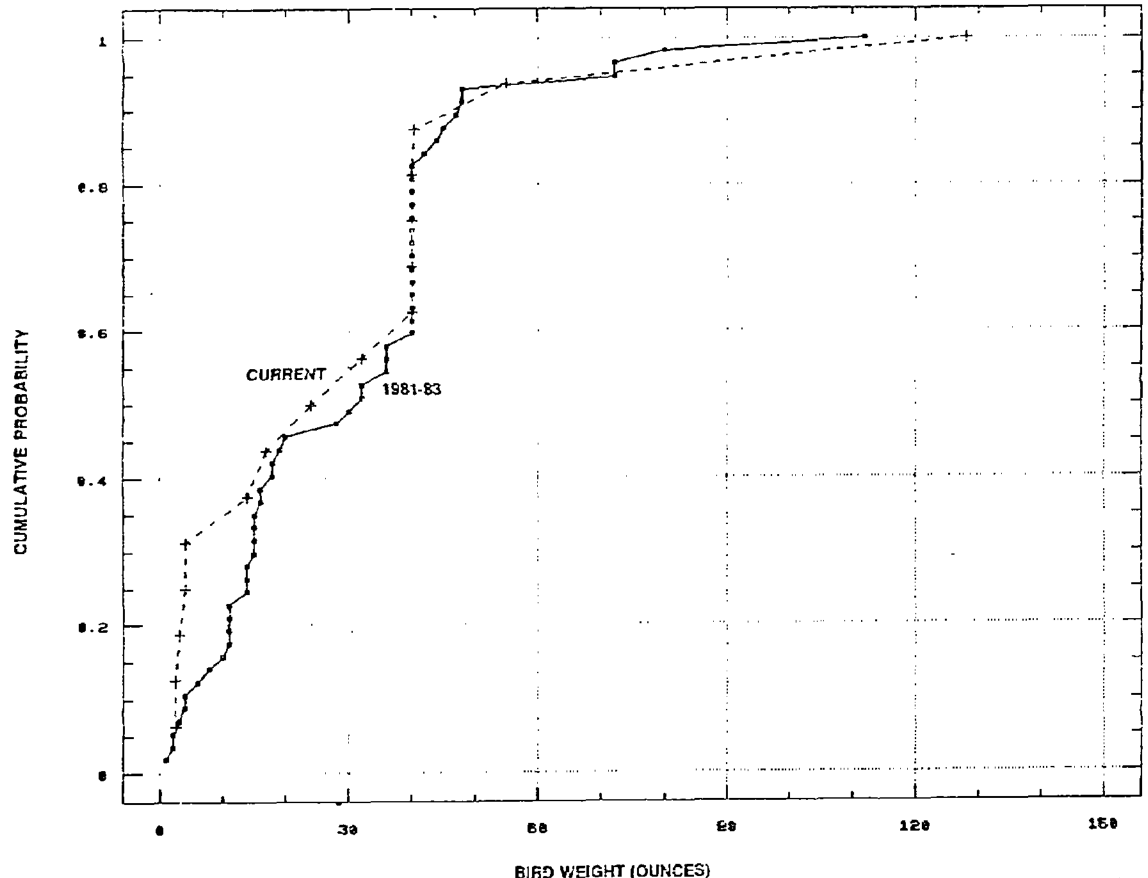
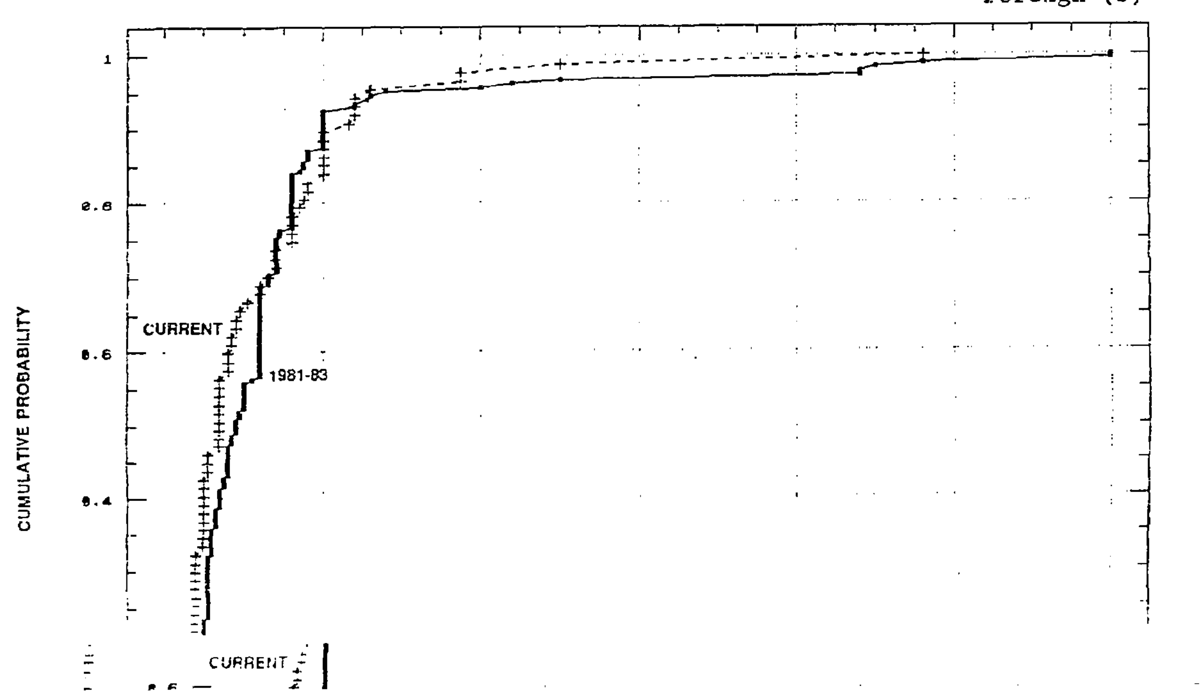


FIGURE 4.2. CUMULATIVE BIRD WEIGHT DISTRIBUTIONS - US VERSUS FOREIGN

United States (a)



Foreign (b)



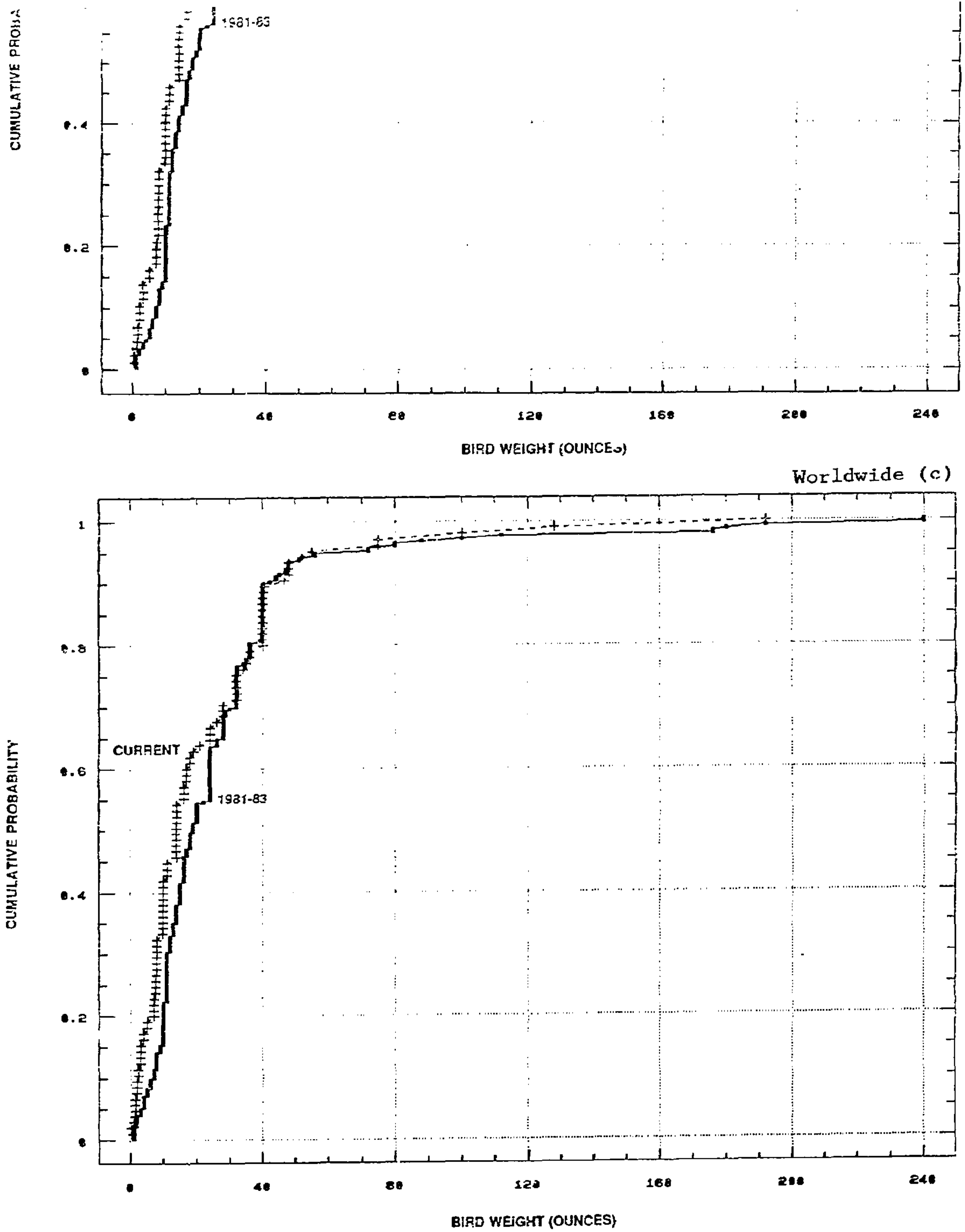
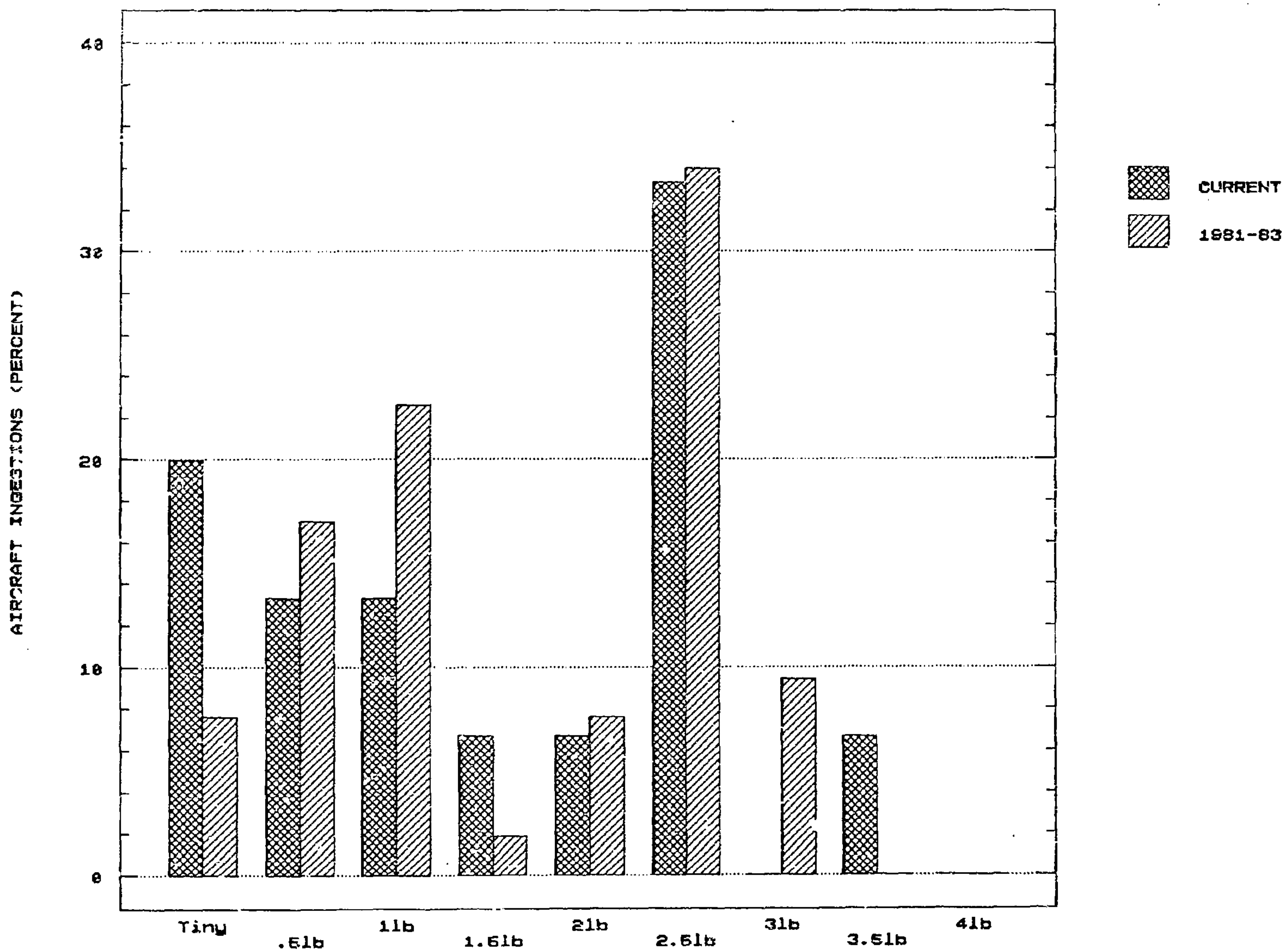
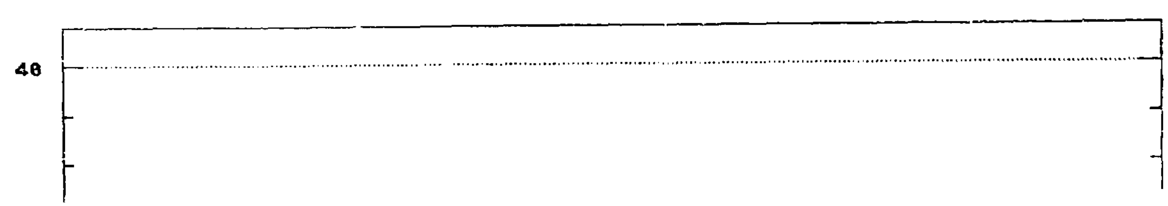


FIGURE 4.3. CUMULATIVE BIRD WEIGHT DISTRIBUTIONS - CURRENT VERSUS 1981-83 STUDY - US/FOREIGN/WORLDWIDE

United States (a)



Foreign (b)



Foreign (b)

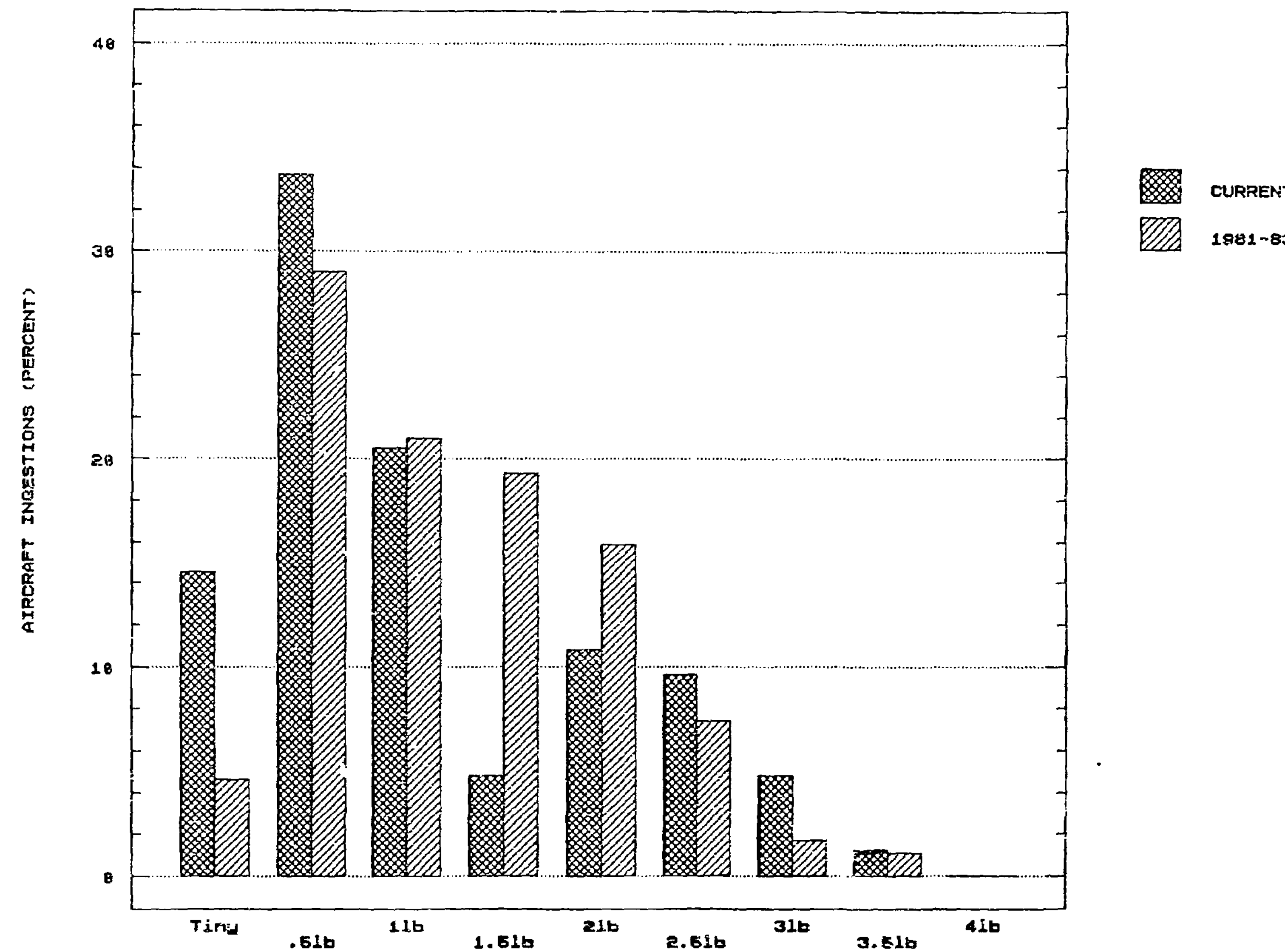


FIGURE 4.4. RELATIVE FREQUENCY BIRD WEIGHT DISTRIBUTIONS - CURRENT VERSUS 1981-83 STUDY - US/FOREIGN

United States distributions are bimodal with about 45 percent of the weights in the 1-pound or smaller classes and about 35 percent in the 2.5-pound class. The foreign distributions are similar in most weight classes. Two exceptions are the "tiny" and 1.5-pound classes. The latter contains relatively fewer weights from the current study while the opposite is true for the former.

As indicated in Section 3, there were 16 multiple engine and 29 multiple bird aircraft events, including 8 that fell into both categories. Bird weights, none of which are over 40 ounces, were obtained in 22 of these 37 events. Figure 4.5 contains a frequency distribution of all bird weights up to the 2.5 pound weight class (the initial portion of figure 4.1). The numbers of single engine-multiple bird (SEMB), multiple engine-single bird (MESB) and multiple engine-multiple bird (MEMB) aircraft events for each weight class are shaded as indicated. The single engine-single bird events (SESB) remain unshaded. The 0.5-pound class contains the greatest number (10) of these "multiple" events, as well as the highest percentage (32 percent). The 1-pound and 2.5-pound classes each contain four "multiple" events, representing 31 percent of the latter's total and 21 percent of the former's. The 1.5-pound class is conspicuous by the absence of any multiple engine or multiple bird events.

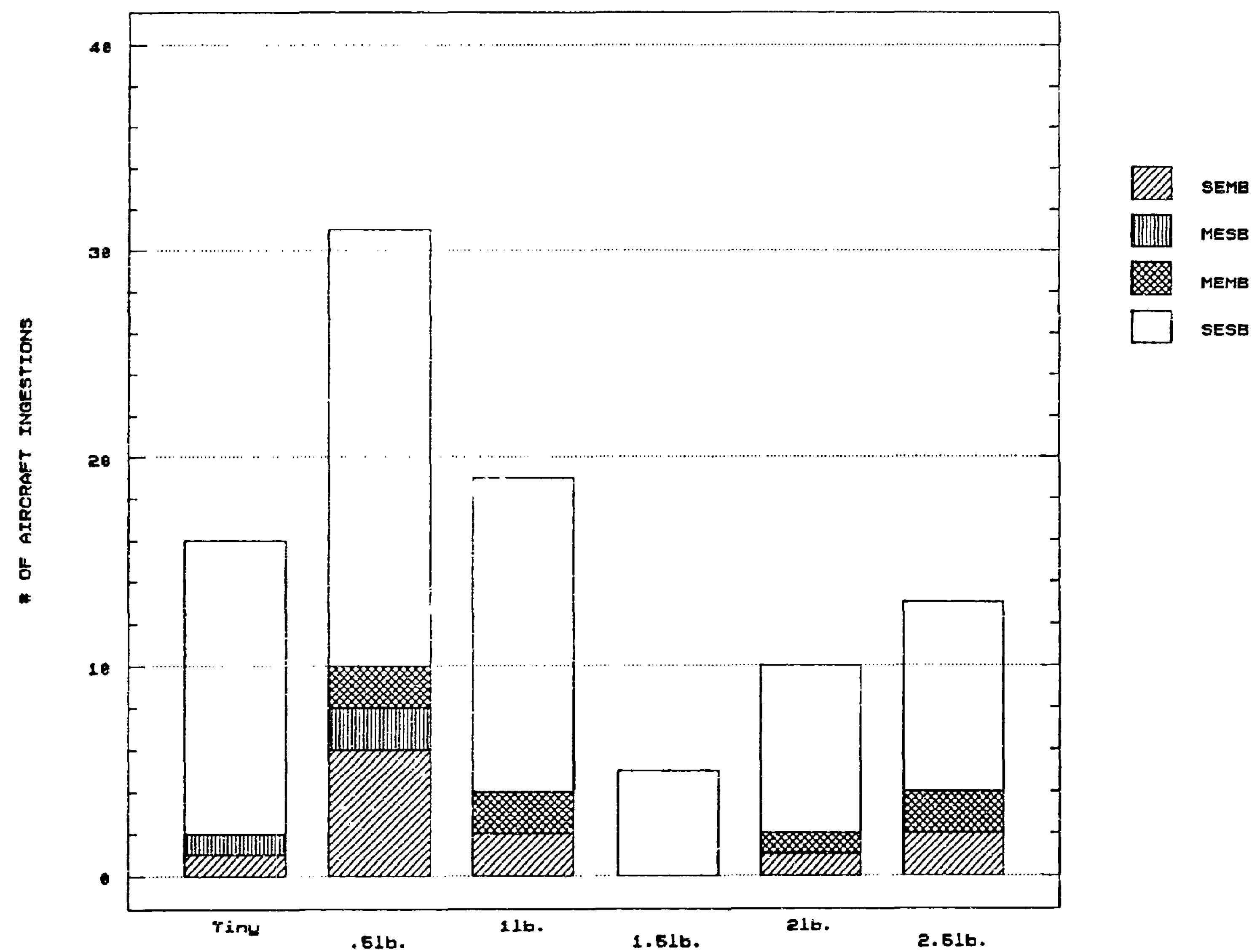


FIGURE 4.5. MULTIPLE ENGINE AND MULTIPLE BIRD EVENTS BY BIRD WEIGHT CLASS

5. EFFECTS ON ENGINES AND FLIGHTS.

The underlying reason for concern about ingestion of birds into aircraft engines is the potential for causing damage to the engines and changes to the aircraft's scheduled flight path by this phenomenon. Aside from economic considerations, these adverse effects can have severe safety repercussions. A B737 crashed on takeoff in Ethiopia in 1988 after both engines failed upon ingesting multiple birds [2]. During this study a B747 narrowly averted disaster after encountering a flock of pigeons during takeoff at Los Angeles (event 138). There are numerous other instances of engine damage and adverse crew actions in the data. These deleterious effects are summarized in this section, and an attempt is made to provide some insight into the relationships among engine damage, effect on flight, and the numbers and weights of ingested birds.

When a bird is ingested into an engine, the first moving part it typically contacts is the fan set. It is usually sliced into pieces by the fan blades, and the resulting matter can go out the bypass ducts or into the primary gas path (core) of the engine. Theoretically, according to the impulse-momentum principle of physics [5], the impulse (integral with respect to time) of the collision force of bird on fan set equals the product of the bird's mass with its striking velocity relative to the fan. For a particular fan set and location of impact, it is this collision force that ultimately determines the stresses, strains, and resulting damage, if any, to the fan blades. These may be nicks, bends, tears, cracks or, in worst cases, pieces of fan blade may break off. Secondary (hard object) damage that can be caused by these pieces is potentially more dangerous to both engine and aircraft than any "soft body" impact between bird matter and machinery.

Thus, all other things being equal, one could expect a direct relationship between "severity" or "extent" of engine damage and mass (weight) of ingested bird. Unfortunately, "all other things" are never quite equal and it is likely that no two bird ingestion events are ever quite the same. There are numerous factors besides bird weight that can influence the effect of a bird ingestion on the engine: the numbers, orientation, and velocity (speed and direction) of the birds; the velocity of the aircraft; the speed and power of the engine; the location and angle of impact; and the engine design. In some cases, a bird is broken up by the inlet cowl and only a portion strikes the fan set. This occurred, for example, in event 118 in which a 12-pound vulture struck the leading edge of the inlet cowl and only a fraction of the bird, believed to be from 1/3 to 1/2, was actually ingested into the engine.

5.1 ENGINE DAMAGE CATEGORIES.

One hundred and eighty-five (185) of the 397 engine ingestion events (47 percent) were reported to have caused some damage to the engine while 211 reported no damage. (It remains undetermined whether event 249 caused any damage to the engine.) Fifteen specific categories of engine damage were tracked in the FAA data base and are defined in table 5.1. The data summary in appendix C specifies all of the damage categories which occurred in each engine event. For purposes of this report, each damage category was classified as "minor" or "significant", as indicated in table 5.1. Engine damage is defined to be "significant" if any "significant" category of damage occurred and "minor" if the engine was damaged, but not significantly. As a result of these definitions, 46 percent of damaging engine ingestions resulted in significant damage and 54 percent in only minor damage. No attempt was made in this interim report to further quantify "damage severity" or to determine "engine failures." These topics will be addressed in the final report for this study.

5.2 ENGINE DAMAGE BY BIRD MULTIPLICITY.

It is natural to ask whether multiple bird ingestions caused "greater damage" than single bird ingestions. Table 4.1 indicated that there were 35 multiple bird and 305 single bird engine events. Table 5.2 is a 3 x 2 contingency table which classifies these 340 engine ingestions according to category of engine damage and single versus multiple bird. For this table, chi-square = 4.91 with df = 2, yielding P = 9%, which is not quite significant statistically. (See appendix B for a discussion of the chi-square test.)

In table 5.2, 13/77 = 16.9 percent of significantly damaging engine ingestions involved multiple birds while the corresponding frequencies are only 6/85 = 7.1 percent and 16/178 = 9.0 percent for the minor damage and no damage categories, respectively. This suggests combining the last two rows of table 5.2 so that only two damage categories are considered. These are (1) significant damage and (2) minor or no damage. For the resulting 2 x 2 contingency table, chi-square = 4.68 with df = 1 which is significant at P = 3%. Hence multiple bird ingestions tend to cause significant damage more often than single bird ingestions. This result should not be surprising since two of the defining categories for significant damage, be/de>3 and torn>3, would be more likely to occur, for a given bird weight, in a multiple bird ingestion.

If, on the other hand, the first two rows of table 5.2 are combined so that the two categories of engine damage being considered are (1) damage (of any sort) and (2) no damage, then chi-square = 0.69 with df = 1, yielding P = 41%. It cannot therefore be concluded that multiple bird ingestions tend to be damaging more than single bird ingestions. It should be noted that the weight and quantity (if greater than two) of birds were not taken into consideration in the above analyses.

5.3 ENGINE DAMAGE BY PHASE OF FLIGHT.

Among the factors previously mentioned which may affect engine damage are engine speed/power and aircraft velocity. Although provision was made in the data base for recording the engine power setting at time of ingestion, this information was actually reported in only 5 of the engine events, while aircraft speed was reported only 49 times. There is, however, a relationship between each of these factors and the phase of flight of the aircraft. For example, fan speed is usually over 90 percent of maximum during the takeoff and climb phases, is roughly 65 percent during final approach, and falls below 40 percent during descent and landing. Since, as noted in Section 3, some indication of fligh phase was reported in nearly 60 percent of the aircraft events, it is natural to examine the relationship between phase of flight and engine damage.

The frequency of significant damage, minor damage, and no damage for each reported category of phase of flight is illustrated in figure 5.1 for the 237 engine events in which this information is known. The "takeoff," "takeoff roll," "climb," "landing roll," and "approach" categories each contain several damaging events. However, more than half of the engine ingestions in each of the latter

TABLE 5.1. ENGINE DAMAGE CATEGORIES - DEFINITIONS

CATEGORY	DESCRIPTION	CLASSIFICATION
LEADEDGE	FAN BLADE LEADING EDGE DISTORTION	MINOR
BEDE<=3	1 TO 3 BENT/DENTED FAN BLADES	MINOR
TORN< =3	1 TO 3 TORN FAN BLADES	MINOR
SHINGLED	SHINGLED (TWISTED) FAN BLADE(S)	MINOR
ACPAFNAB	ACOUSTIC PANEL OR FAN RUB STRIP DAMAGED	MINOR
NACELLE	ENGINE ENCLOSURE DENTED OR PUNCTURED	MINOR
BEDE>3	MORE THAN 3 FAN BLADES BENT/DENTED	SIGNIFICANT
TORN>3	MORE THAN 3 FAN BLADES TORN	SIGNIFICANT
BROKEN	FAN BLADE LEADING EDGE OR TIP PIECES MISSING	SIGNIFICANT
TRVSFRAC	FAN BLADE BROKEN CHORDWISE, PIECE LIBERATED	SIGNIFICANT
RELEASED	BLADE RETENTION MECHANISM FAILED	SIGNIFICANT
FLANGE	FLANGE SEPARATIONS	SIGNIFICANT
CORE	COMPRESSOR BLADES/VANES DMGD. OR AIRFLOW BLOCKED	SIGNIFICANT
TURBINE	TURBINE DAMAGED	SIGNIFICANT
SPINNER	SPINNER/CAP DAMAGED	SIGNIFICANT

TABLE 5.2. ENGINE DAMAGE CATEGORIES BY BIRD MULTIPLICITY

	SINGLE	MULTIPLE	TOTALS
SIGNIFICANT	64 (83.1%)	13 (16.9%)	77
MINOR	79 (92.9%)	6 (7.1%)	85
NONE	162 (91.0%)	16 (9.0%)	178
TOTALS	305	35	340

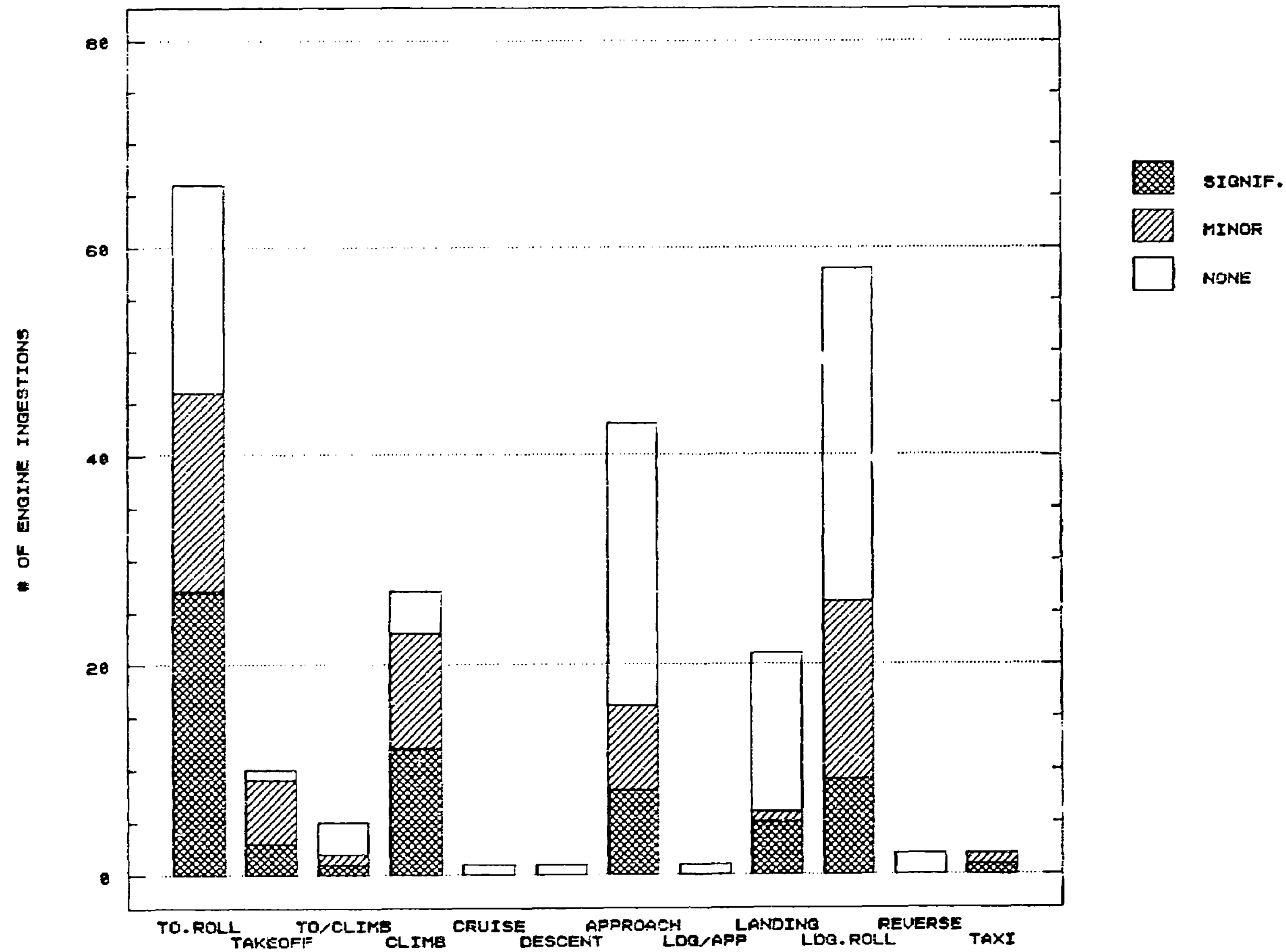


FIGURE 5.1. ENGINE DAMAGE FREQUENCIES BY PHASE OF FLIGHT

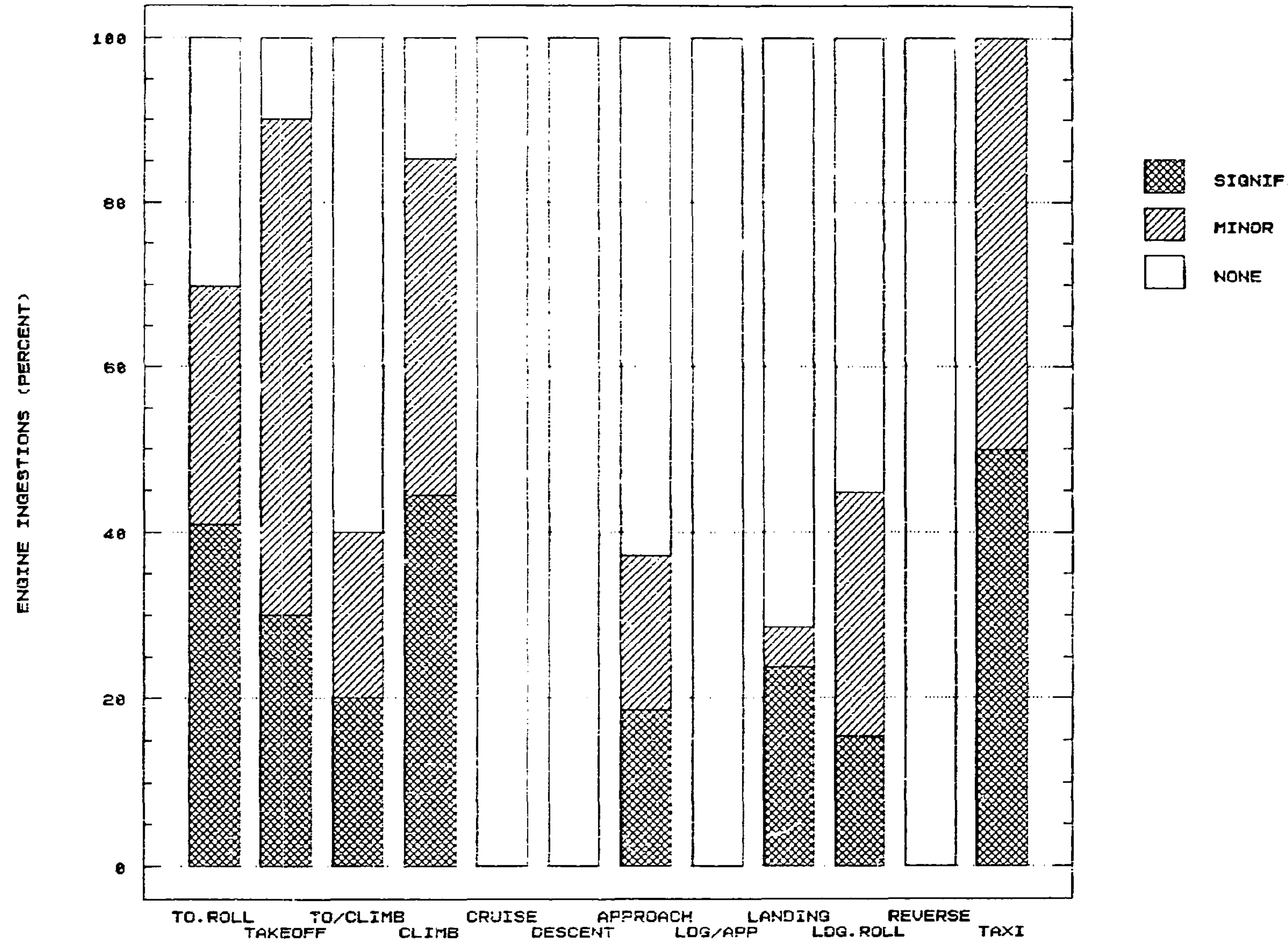


FIGURE 5.2. RELATIVE FREQUENCY OF ENGINE DAMAGE BY PHASE OF FLIGHT

two categories were nondamaging. This suggests looking at the "relative frequencies" of damage for each phase of flight category, which is shown in figure 5.2. Clearly the "climb," "takeoff," "takeoff roll," and "taxi" phases have the highest percentages of both minor and significant damage. However, as figure 5.1 shows, the taxi phase contains only two events. Among the departure phases, only the "takeoff/climb" category (which contains but 5 events) has relatively few damaging events. These facts, along with the above remarks concerning fan speed in various phases of flight, suggest grouping phases of flight according to "departure" and "arrival" for analysis of engine damage.

Table 5.3 is a 3 x 2 contingency table which compares the aforementioned two phase-of-flight categories with the usual three categories of engine damage. In this table "departure" includes all takeoff or climb phases while "arrival" represents the descent, approach, or landing phases. (The five "cruise," "reverse," or "taxi" events have been excluded.) For table 5.3, chi-square = 29.9 with df = 2, giving a P-value near 0. Hence it is a statistical certainty that the factors in table 5.3 are dependent. Note that 43/65 = 66.2% of the significantly damaging engine ingestions and 37/63 = 58.7% of those with minor damage occurred during takeoff or climb. In contrast, only 28/104 = 26.9% of nondamaging engine events occurred during departures.

If the first two rows of table 5.3 are combined, yielding the damage categories (1) damage (of any sort) and (2) no damage, then chi-square = 29.2 with df=1, giving a P-value near 0. On the other hand, if the last two rows of table 5.3 are combined giving the damage categories (1) significant damage and (2) minor or no damage, then chi-square = 13.9 with df = 1, which also gives a P-value near 0. Hence in both 2 x 2 contingency tables, the respective damage categories and phases of flight are dependent. Therefore, "departure" ingestions tend to cause both damage and significant damage more often than "arrival" ingestions.

5.4 ENGINE DAMAGE BY BIRD WEIGHT.

The relationship between engine damage and weight of ingested birds is examined next. Figure 5.3 is a frequency histogram depicting engine damage category according to bird weight class for the 115 engine ingestions in which a species identification was made. The weight classes are the same as those used in the previous section, as defined in table 4.5. The number of engine ingestions that resulted in no damage, minor damage, and significant damage is shown for each weight class. The 2.5-pound weight class had the greatest number of events with significant damage while the 1.5-pound and 2-pound weight classes had relatively few. Three (3) of the four ingestions in the 3-pound class caused damage. All ingestions over 3 pounds were damaging, for the most part significantly, but were few in number. The 0.5-pound class contains a large number of damaging ingestions but more than half in this class were nondamaging.

As figure 5.3 indicates, engine damage information was not reported for one (2-pound) ingestion. Using the remaining 114 engine events, figure 5.4 examines bird weight versus engine damage from the relative frequency viewpoint. Here the percentage in each damage category is represented for each weight class. With few exceptions, the overall trend is for the relative frequency of both damaging and significantly damaging ingestions to increase with bird weight.

In reference 2, a logistic model is used for the probability of various "severities" of damage as a function of bird weight. Specifically, the logarithm

TABLE 5.3. ENGINE DAMAGE CATEGORIES BY DEPARTURE/ARRIVAL

	DEPARTURE		ARRIVAL		TOTALS
SIGNIFICANT	43	(66.2%)	22	(33.8%)	65
MINOR	37	(58.7%)	26	(41.3%)	63
NONE	28	(26.9%)	76	(73.1%)	104
TOTALS	108		124		232

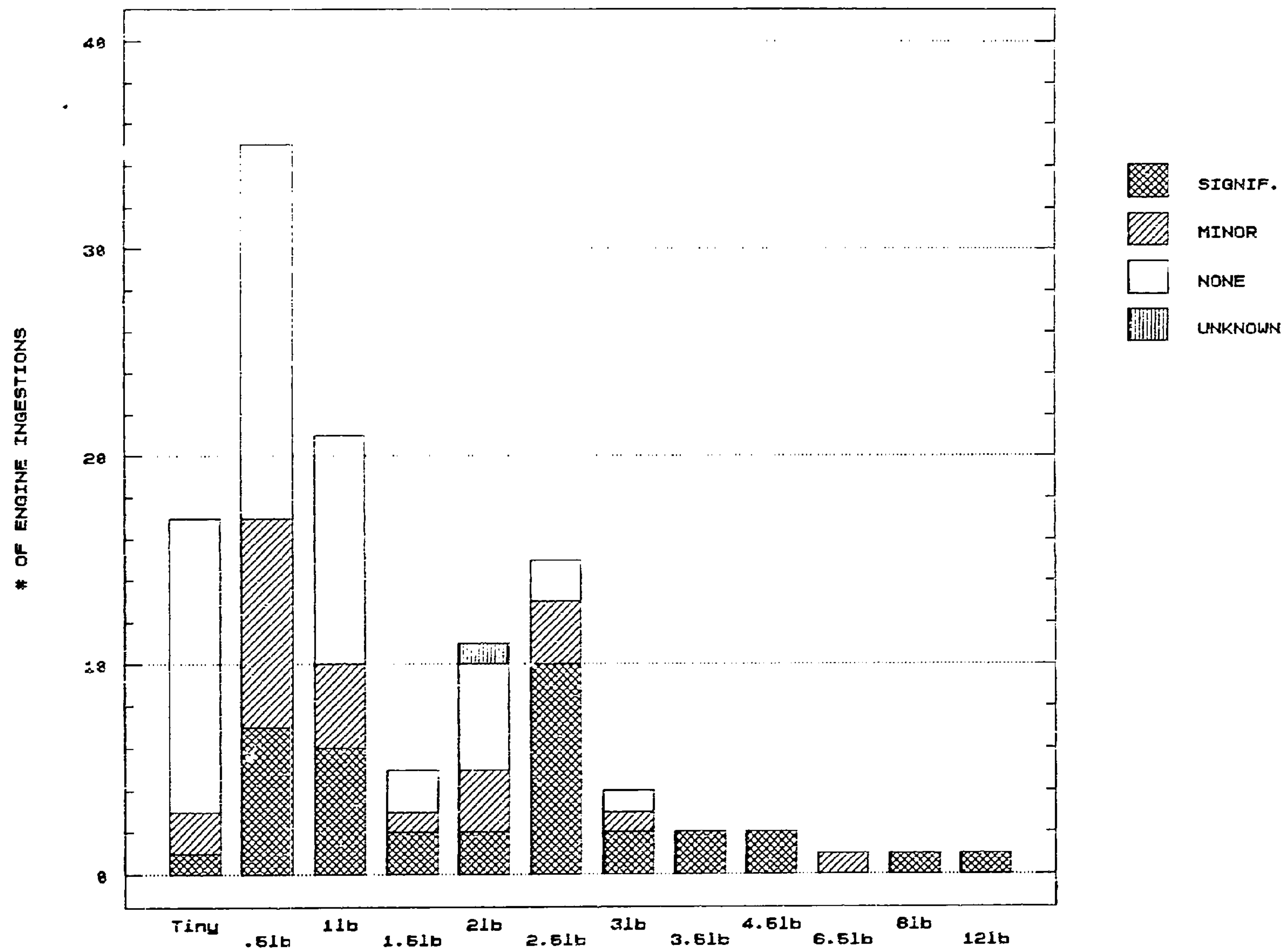


FIGURE 5.3. ENGINE DAMAGE FREQUENCIES BY BIRD WEIGHT CLASS

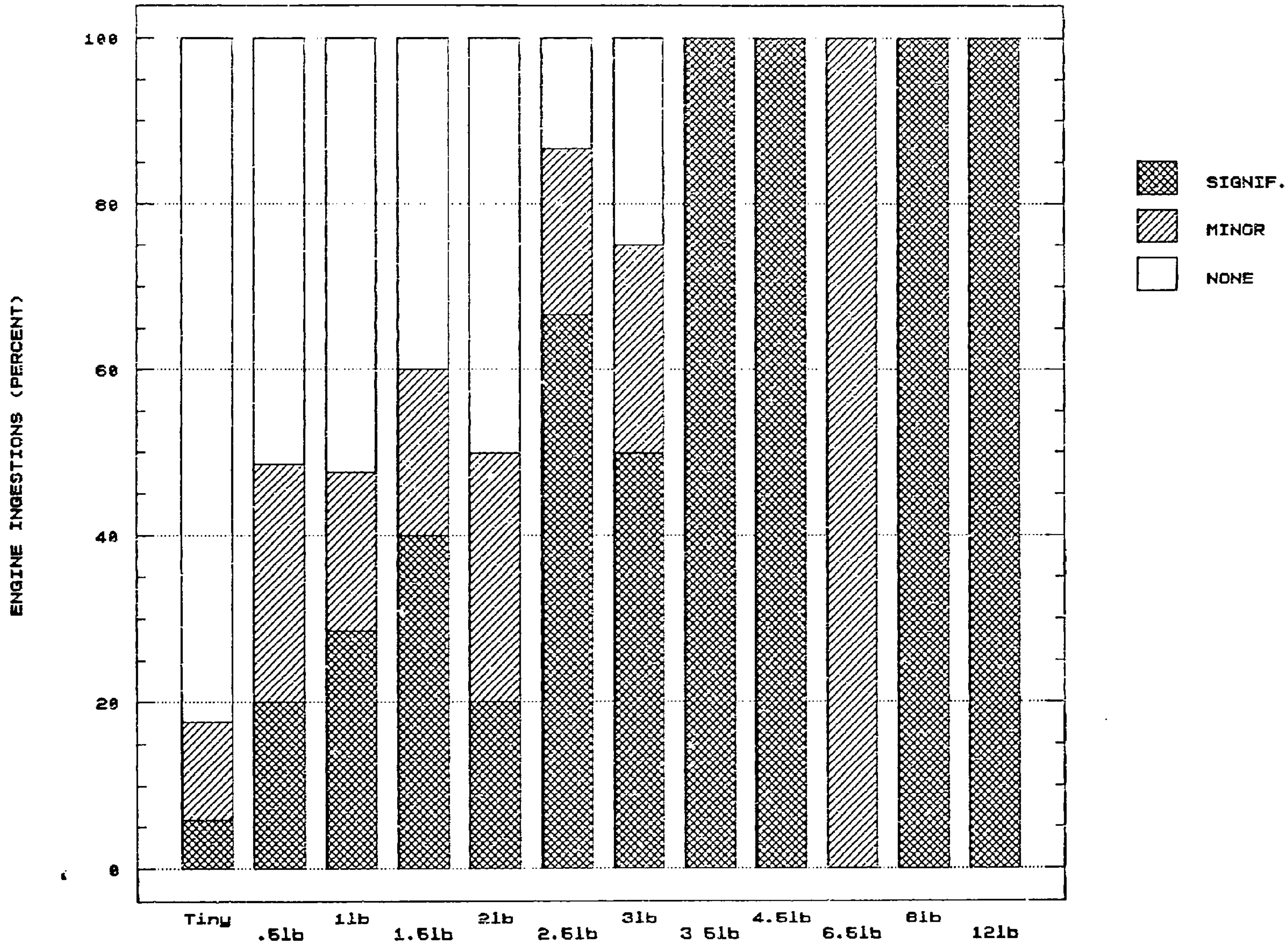


FIGURE 5.4. RELATIVE FREQUENCIES OF ENGINE DAMAGE BY BIRD WEIGHT CLASS

of the odds ratio, log (probability/(1-probability)), is modeled as a linear function of bird weight. A rationale for choosing this particular model is also presented there. The same computer program used in reference 2, which also generates a lower 95 percent confidence bound, was applied to the data in this report. The resultant probability of damage (resp. significant damage) curves are given in figure 5.5 (resp. figure 5.6). The probability of damage reaches 50 percent at about 10.7 ounces and the probability of significant damage curve does likewise at 36 ounces. It should be kept in mind, however, that these probability curves are a result of "smoothing" the data which generated figure 5.4 by means of a particular model and should not be taken as gospel. For example, figure 5.6 puts the probability of significant damage at around 50 percent for a 2-pound bird ingestion while figure 5.4 places it at 20 percent. It should also be noted that this model assumes that probability of damage increases with bird weight. Moreover, no factors other than bird weight were used to generate the curves in figures 5.5 and 5.6. In particular, the phase of flight and the number of birds ingested were both ignored.

5.5 CREW ACTION EVENTS.

There were 13 aborted takeoffs (ATO's) among the aircraft events. Three of these involved multiple engines or multiple birds. Besides the ATO's there were 40 other occasions of an adverse "crew action," i.e., a change in the planned flight path of the aircraft. These included 33 air turnbacks (ATB's), 6 diversions to a landing at an unscheduled airport (DIV's), and 1 change of altitude (ALT) on a subsequent flight. Four of these 53 events involved multiple engines and 7 involved multiple birds, including 2 aircraft ingestions that were both multiple engine and multiple bird events.

Figure 5.7 is a tree diagram which indicates the damage category breakdown for each of the above classes of crew action events. The "damage category of an aircraft event" (none, minor, or significant) is defined to be the most severe category of damage sustained by any engine on the aircraft. Thirty-one (31) of the 33 ATB events were damaging, 19 significantly. These totals include one event (317) in which an engine sustained extensive turbine damage and, upon inspection, was discovered to have ingested a single 1-ounce bird on some prior flight. The engine damage, which was caused by a casting defect, was unrelated to the bird ingestion. (This event was considered nondamaging in all engine damage versus bird weight analysis.) Half of the DIV events involved significant damage as did 38 percent of the ATO's. Five of the eight nondamaging crew action events were ATO's. An engine "surge" was noted in four ATO events. In one of these, event 152, both engines surged but only one engine sustained damage. The three other events (22, 34, and 215) were all single engine and nondamaging. Event 22 resulted in an engine in-flight shutdown (IFSD).

There are nine other occurrences of an IFSD in the 53 crew action events. The IFSD's are indicated in the next level of the tree in figure 5.7. Seven of these, six of which involved significant engine damage, are in the ATB's. All IFSD events are discussed below.

Verified bird weights were obtained in 28 of the 53 crew action events. Figure 5.8 indicates the bird weight class involved in each of these events, and for the "no crew action" and "unknown crew action" events as well. The greatest number of crew action events, eight, occurred in the 0.5-pound class, followed by seven for the 2.5-pound class. This latter class, however, contains the

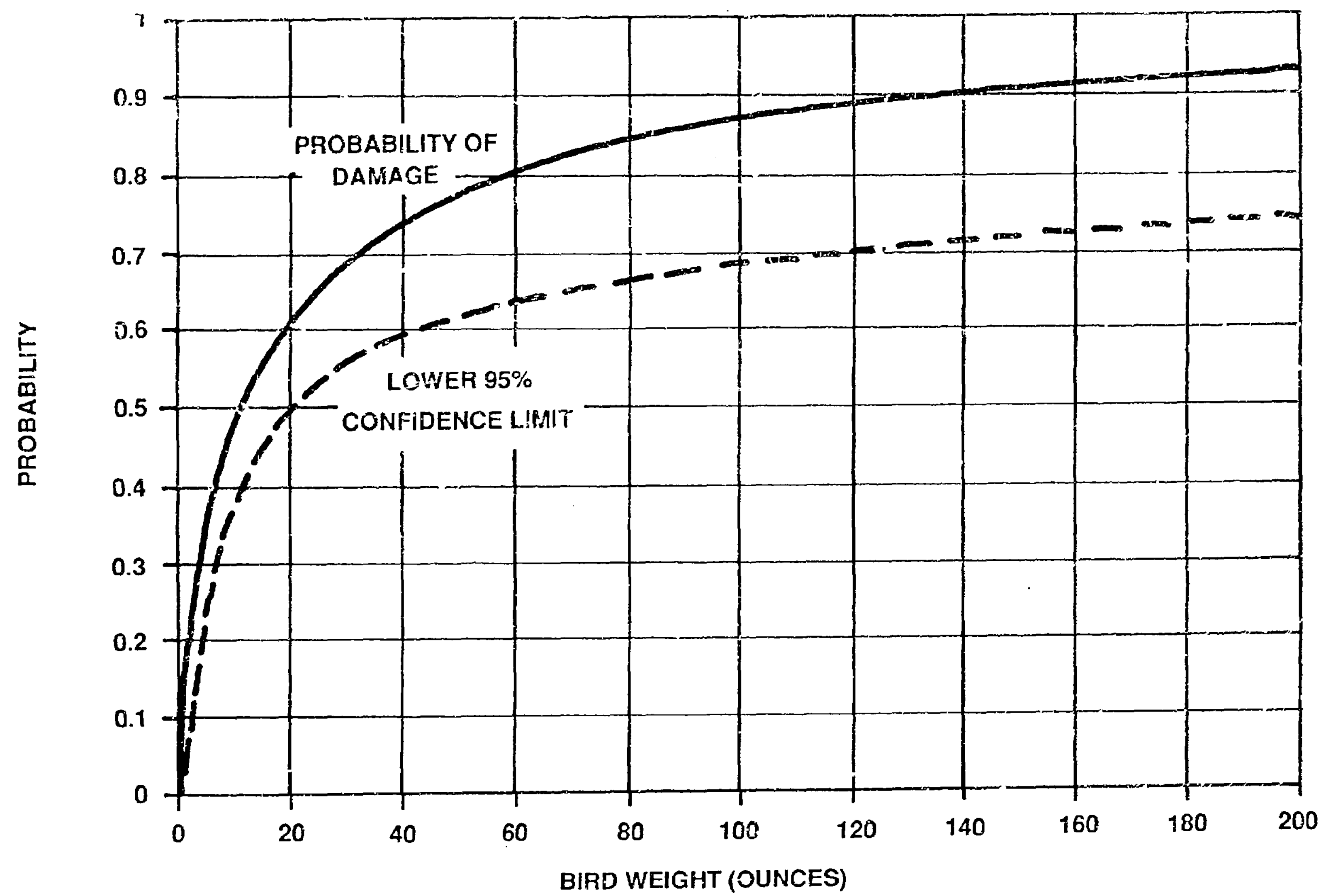


FIGURE 5.5. PROBABILITY OF ENGINE DAMAGE BY BIRD WEIGHT - LINEAR LOGISTIC MODEL

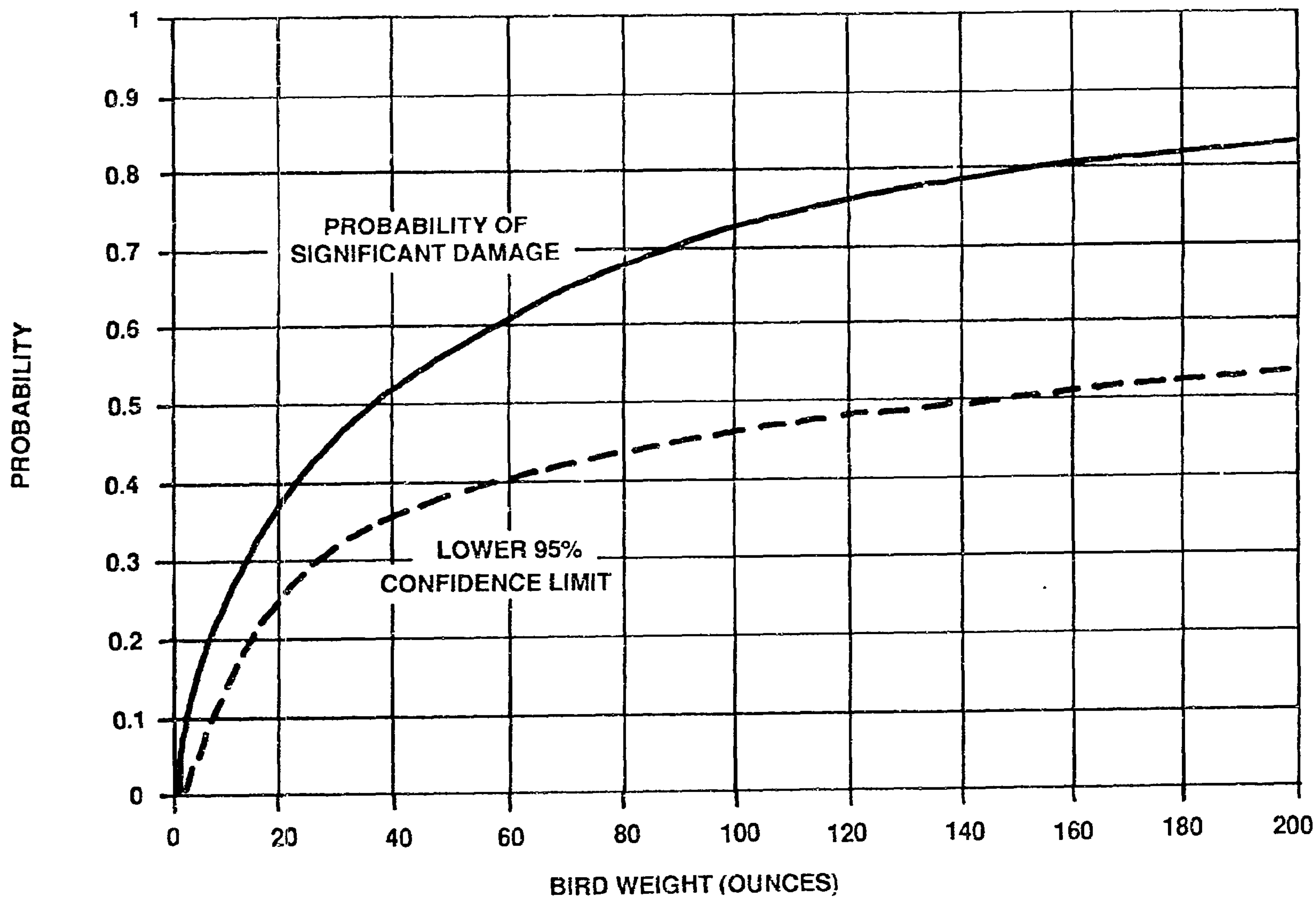


FIGURE 5.6. PROBABILITY OF SIGNIFICANT ENGINE DAMAGE BY BIRD WEIGHT - LINEAR LOGISTIC MODEL

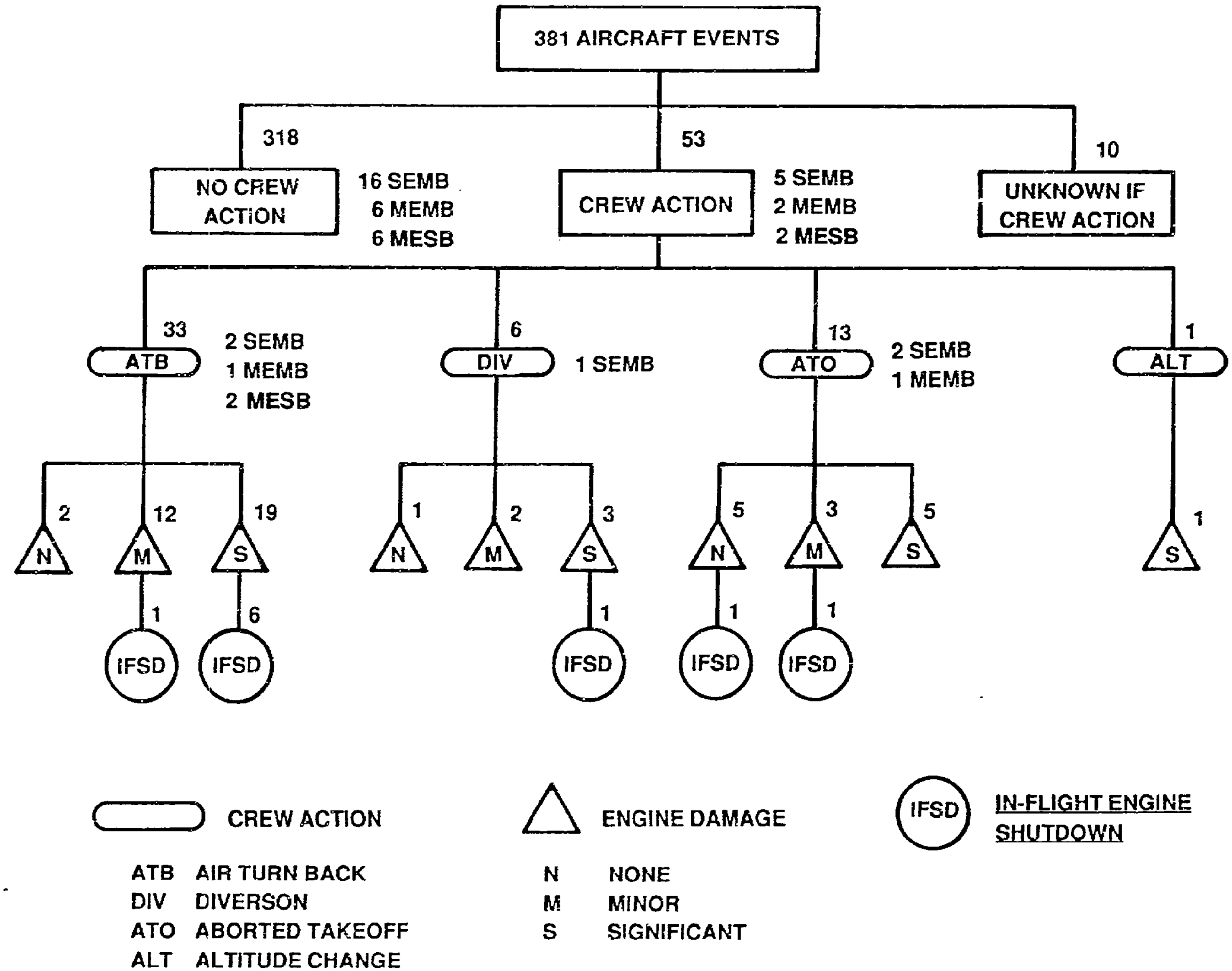


FIGURE 5.7. CREW ACTION TREE DIAGRAM

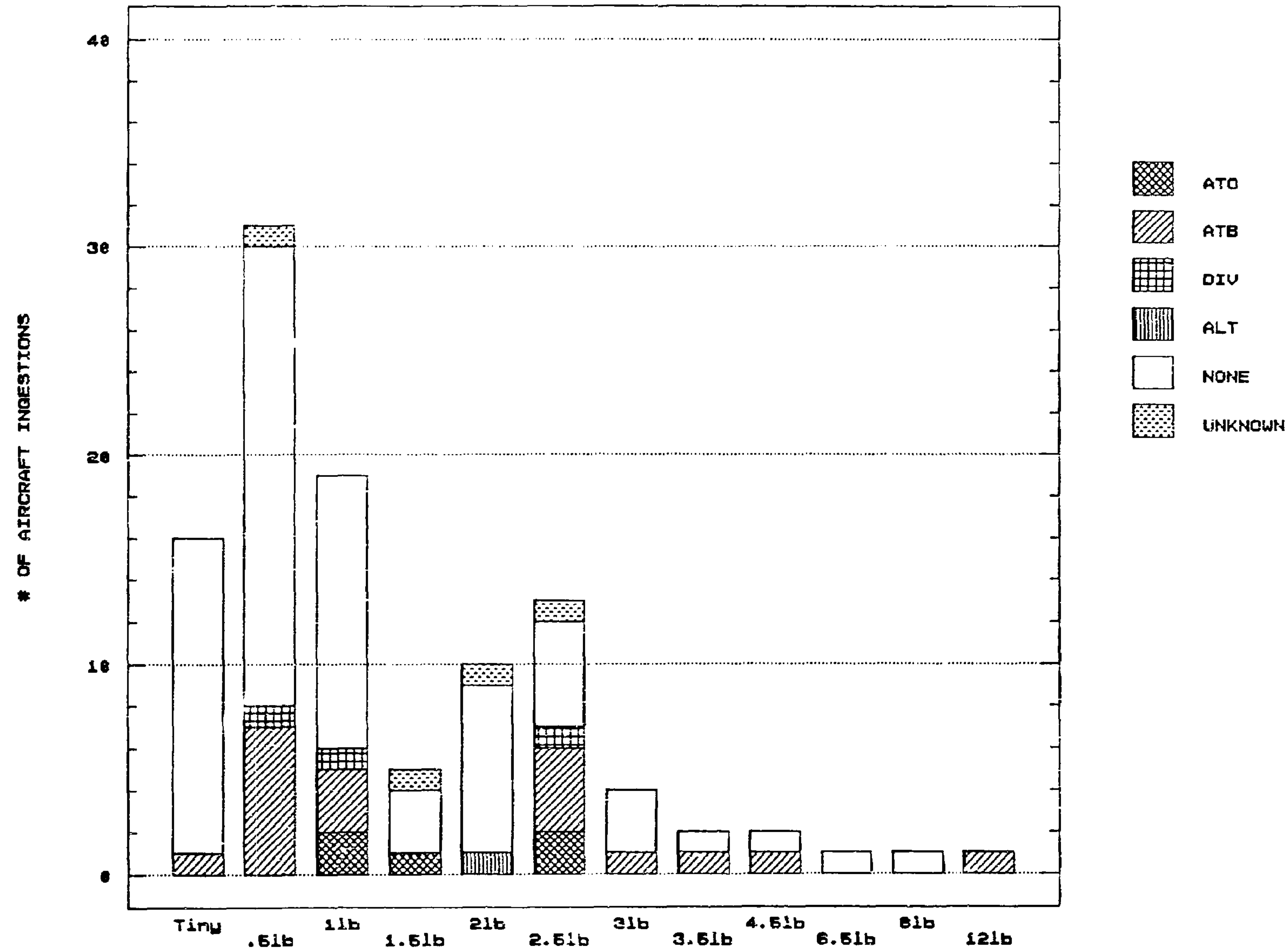


FIGURE 5.8. CREW ACTIONS BY BIRD WEIGHT CLASS

largest relative frequency of crew action events, 54 percent. The aforementioned event (317) in which an ATB was evidently unrelated to the bird ingestion, accounts for the single "tiny" bird event in figure 5.8.

5.6 IN-FLIGHT SHUTDOWN EVENTS.

As previously noted, 10 of the "crew action" events resulted in an IFSD. All told, there are 11 IFSD events in the data, which are summarized in table 5.4. A "Y" denotes occurrence and a "blank" nonoccurrence. Acronyms used for phases of flight are defined in appendix C. Multiple birds were ingested into three of the engines that were shut down in flight. There were no multiple engine IFSD's although in event 138, two engines of the B747 ingested birds. No cause was given for the IFSD in event 317, which, as noted above, sustained turbine damage unrelated to the bird ingestion. In the remaining nine events, increased engine vibration was cited seven times as a contributing factor. Other symptoms given in IFSD's were high exhaust gas temperature (three times), an engine surge (twice), and a bird smell (once). An involuntary power loss was reported in 5 of the 11 IFSD events. Verified bird identifications were obtained in 7 events. Four of these involved birds in the 2.5-pound weight class of which three (events 32, 241, and 247) were herring gulls. Three herring gulls were ingested into a single engine in event 32.

5.7 UNCONTAINED EVENTS.

As noted at the beginning of this section, fragments from broken fan blades can cause secondary damage to the engine following a bird ingestion. These fragments sometimes exit through the engine's case or nacelle (an "uncontained" event) and have the potential for seriously damaging the aircraft. There were no incidents of engine case uncontainment; although in two events (74 and 103), blade fragments punctured the metallic engine casing but were contained by the Kevlar containment system. In the latter event, fragments did exit through the nacelle. Event 103 and the four additional instances of uncontained nacelle damage are summarized in table 5.5. Fortunately, there were no reports of further damage to the aircraft in any of the uncontained events; although in event 241, a piece of blade from one engine ricocheted off the runway and struck the adjacent engine of the B747. Both affected engines in event 138 received uncontained damage to the nacelle. Bird identifications were obtained in all uncontained events. Herring gulls weighing 2.5 pounds were cited in two of these events (and also in the aforementioned event 74). The other three uncontained events all resulted from ingestions of multiple birds in the 1-pound weight class.

5.8 INVOLUNTARY POWER LOSS EVENTS.

An involuntary loss of power was reported in six engine events. As noted above, five of these resulted in a mandatory IFSD and are included in table 5.4. In the other, event 103, the engine was not shut down but rather was reversed during an aborted takeoff. This was an uncontained event and appears in table 5.5.

5.9 MULTIPLE ENGINE EVENTS.

All transport category aircraft are certificated to perform safely, during all flight phases, with any single engine inoperable. (See CFR Title 14, Part 25.) Multiple engine ingestion events are of particular interest because an in-flight

TABLE 5.4 IN-FLIGHT SHUTDOWN EVENTS

evt #	date	acft	eng	eng pos	crew actn	pow loss	surge	smell	inc vibe	hi egt	trvs frac	bird wt	mult bird	eng dmg	pof
22	04/12/89	B747	JT9D	1	ATO		Y							N	TR
32	05/10/89	A300	JT9D	1	ATB	Y	Y			Y		36	Y	S	TR
140	07/25/89	A320	V2500	1	ATO			Y					Y	M	TR
75	08/14/89	B767	CF6	1	ATB	Y			Y			48		S	CL
76	08/18/89	A310	CF6	1					Y					M	CL
138	09/12/89	B747	JT9D	2	ATB	Y			Y	Y	Y	14	Y	S	TR
267	05/04/90	A320	CFM56	1	ATB				Y					M	TR
247	05/31/90	A300	JT9D	1	ATB	Y			Y	Y		40		S	TR
241	06/27/90	B747	JT9D	3	DIV				Y			40		S	TR
257	07/30/90	B757	2000	2	ATB	Y			Y			40.4		S	CL
317	08/10/90	A300	4000	1	ATB							1		N	TC

TABLE 5.5 UNCONTAINED EVENTS

evt #	date	unc case	unc nacl	acft	eng	eng pos	ifsd	pow loss	surge	inc vibe	hi egt	trvs frac	bird wt	mult bird	pof
138	09/12/89		Y	B747	JT9D	1			Y				14	Y	TR
138	09/12/89		Y	B747	JT9D	2	Y	Y	Y	Y	Y	Y	14	Y	TR
103	10/23/89		Y	A310	CF6	1		Y		Y		Y	16	Y	TR
231	03/16/90		Y	A300	JT9D	2				Y			40		CL
241	06/27/90		Y	B747	JT9D	3	Y			Y			40		TR

loss of two engines during the critical takeoff or climb phases could be catastrophic, even in three- or four-engine aircraft. Table 5.6 summarizes the 16 multiple engine events in the data, all of which involved two engines. In event 138, one engine lost power due to a fan blade transverse fracture and was shut down. The cockpit symptoms following ingestion were a surge and high exhaust gas temperature. The other affected engine also surged and, fortunately, recovered. This is the only event in which two engines were damaged significantly. Three other events, 102, 201, and 323, resulted in multiple engine damage. Significant damage in a single engine occurred in the first and the last of these events. The B767 in event 201 received minor damage in each engine and performed an air turnback. As noted above, both engines of the B767 in event 152 surged, but evidently recovered. The takeoff was aborted. It is interesting to note that the affected engines were on the same wing in all four B747 multiple engine events. Verified bird weights were obtained in 10 of the multiple engine events. They are listed in table 5.6 and were included in figure 4.5 of the previous section.

TABLE 5.6. MULTIPLE ENGINE EVENTS

evt #	date	acft	eng	eng pos	eng dmg	crew actn	pow loss	surge	ifsd	inc vibe	hi egt	trvs frac	bird wt	mult bird	pof
97	12/14/89	A310	CF6	1	M								10	Y	LR
				2	N								10	Y	
193	01/16/90	A310	CF6	1	N										
				2	N										
244	02/09/90	A310	JT9D	1	N										
				2	[illegible]										
85	11/21/89	A320	CFM56	1	N										
				2	N										
102	10/21/89	B747	CF6	3	S										CL
				4	M										
138	09/12/89	B747	JT9D	1	S	ATB		Y					14	Y	TR
				2	S		Y	Y	Y		Y	Y	14	Y	
171	08/31/89	B747	4000	3	N									Y	LR
				4	N									Y	
392	09/04/90	B747	CF6	1	N								10	Y	LR
				2	N								10	Y	
1	01/24/89	B757	RB211	1	N	ATB							8		TR
				2	M								8		
112	10/07/89	B757	RB211	1	N										LD
				2	N										
214	06/17/90	B757	RB211	1	N								32	Y	LD
				2	N								32	Y	
323	08/14/90	B757	2000	1	S								40	Y	TO
				2	M								40		
24	04/18/89	B767	JT9D	1	N								0.5		
				2	N								0.5		
152	10/12/89	B767	JT9D	1	N	ATO		Y					18	Y	TR
				2	M			Y					18	Y	
201	02/21/90	B767	CF6	1	M	ATB							7.7		TR
				2	M								7.7		
225	02/21/90	B767	JT9D	1	S								36	Y	AP
				2	N								36		

6. SUMMARY AND CONCLUSIONS.

Data in this report were generated by a fleet of over 1100 aircraft flying more than 2 million operations worldwide during the period January 1989 to September 1990.

A total of 381 aircraft ingestions was reported, yielding a worldwide ingestion rate that is approximately 80 percent of the rate in the 1981-83 FAA study. The foreign aircraft ingestion rate is currently over four times the domestic rate compared with two and one-half times in the previous study. More effective bird control measures at United States airports is one possible explanation for this disparity. It is also conceivable that foreign carriers have been more diligent than domestic carriers in reporting bird ingestions.

Aircraft ingestions were reported to have occurred at 120 different airports worldwide. One airport had 10 events and two others had 7 each. All three were outside the United States. The largest number of events at any domestic airport was four.

There were 16 multiple engine events, yielding a rate slightly under 8 per million operations. Each involved two engines of the aircraft. Thirty-five (35) of the 397 engine ingestions are known to have involved multiple birds.

The species of birds ingested are consistent with the 1981-83 study. The herring gull, common lapwing, black-headed gull, and common rock dove were the most frequently identified species. The first three were also the most frequently encountered birds during multiple engine or multiple bird ingestions.

Bird weights, both domestic and foreign, are markedly similar to those in the previous study. This is true not only in terms of summary statistics (median, mode, mean, etc.) but also in terms of the distribution functions for the weights. As before, birds ingested in the United States tend to be heavier than foreign birds.

Forty-seven (47) percent of engines that ingested birds had some reported damage, compared to 62 percent in previous study. Fifty-four (54) percent of current engine damage was classified as "minor," which typically consisted of leading edge distortions or at most three bent, dented, or torn fan blades.

The aircraft ingestion events were fairly evenly split between departure (takeoff or climb) and arrival (descent, approach or landing) phases of flight. However, engines ingesting birds during departures sustained damage at about twice the rate as in arrivals.

An unscheduled crew action was performed in 14 percent of the aircraft events, which is half the rate in the previous study. There were 11 in-flight engine shutdowns, representing less than 3 percent of all engine events. In the previous study, nearly 13 percent of engine events resulted in an IFSD.

The engines included in the current study were designed and certificated to more stringent bird ingestion standards than most of those from the previous study. It is therefore not surprising that the current fleet has performed better in terms of the adverse effects of bird ingestions on engines and flights. However, one needs to simply recall the near-catastrophic B747 multiple engine event in Los Angeles to be convinced that the ingestion of birds into engines continues to present a serious threat to aircraft safety.

Table 6.1 contains a summary of some data from the current and previous FAA studies. Except where noted, all numbers represent worldwide data.

TABLE 6.1. DATA SUMMARY

	Current Study	1981-83 Study
# aircraft	1162 (5/90)	1513 (6/84)
# operations	2,056,676	2,738,320
# aircraft ingestions *	34/333/381	97/484/638
ingestion rate (x 10^-4) *	0.54/2.34/1.85	0.99/2.80/2.33
# multiple engine events	16	25
multiple engine ingestion rate (x 10^-6)	7.78	9.86
# engine ingestions	397	666
# multiple bird engine ingestions	35	65
% multiple bird ingestions	8.8	9.8
# damaging engine ingestions	185	416
% damaging engine ingestions	47	62
median bird weight (oz.) *	28/14/14	32/18/19
modal bird weight (oz.) *	40/14/40	40/24/40
mean bird weight (oz.) *	30/22/23	30/27/27
# crew action a/c events	53	129
% crew actions	13.9	28.2
# IFSD engine events	11	85
% IFSD's	2.8	12.8

* US/FOREIGN/WORLDWIDE

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8. GLOSSARY.

Aircraft operation - One complete flight cycle of an aircraft, from engine startup at departure to engine shutdown upon arrival.

Bird ingestion - The entrance of a bird into the inlet of a turbine engine during an aircraft operation.

Engine ingestion event - The simultaneous ingestion of one or more birds into an engine.

Aircraft ingestion event - The simultaneous ingestion of one or more birds into one or more engines of an aircraft.

APPENDIX A

BIRD INGESTION CERTIFICATION STANDARDS

The following is a summary of current bird ingestion certification standards as they pertain to engines in this study. The complete regulations, which were last amended in February 1984 are contained in 14 CFR 33.77. The small (3-ounce size) bird test mentioned there has been omitted from this summary. It does not apply to engines in this study since none of them have inlet guide vanes.

TEST REQUIREMENT	MEDIUM BIRD TEST	LARGE BIRD TEST
BIRD SIZE	1.5 pound	4 pound
# OF BIRDS	1 for the first 300 square inches of inlet area plus 1 for each additional 600 square inches or fraction thereof.	1
MAXIMUM NUMBER OF BIRDS	8	1
BIRD SPEED	Initial climb speed of typical aircraft.	Liftoff speed of typical aircraft.
ENGINE OPERATION	Takeoff	Takeoff
INGESTION PATTERN	In rapid sequence to simulate a flock encounter and aimed at critical areas.	Aimed at critical areas.
POST INGESTION REQUIREMENTS: Ingestion may NOT	1. Cause more than 25% sustained power or thrust loss. 2. Require engine shutdown within 5 minutes. 3. Result in a potentially hazardous condition.	Cause engine to: 1. Catch fire. 2. Burst. 3. Generate loads greater than maximum specified. 4. Lose capability of being shut down.

APPENDIX B

STATISTICAL TERMINOLOGY

Sample mean. The mean of a sample of size n is the average of the n numbers. It is obtained by summing the numbers and dividing by n.

Sample median. The median of a sample is the observation in the middle of the sample. That is, half the observations are at least as large as the median and half are as small as the median or smaller. We commonly find the median by sorting the sample and taking the middle observation, or observations, in the sorted sample. For example, the sample 1 3 2 6 8 is sorted to give 1 2 3 6 8, and the median is 3, the 3rd largest number. Or the sample 3 7 5 6 9 3 is sorted to give 3 3 5 6 7 9, and the median is 5.5, the average of the 3rd and 4th observations.

Sample mode. The mode is the most frequently occurring observation in the sample. In the 2nd example illustrating the median, the mode is 3. The mean, median, and mode are usually close together in moderate size, or larger, samples whose histograms are bell-shaped.

Sample variance. The sample variance is computed in three steps: (1) Centering the sample, by subtracting the sample mean from each observation. (2) Summing the squares of the centered observations. (3) Dividing by the sample size less 1, n - 1. The variance is the average squared deviation of the observations from their mean.

Sample standard deviation (SD). The sample standard deviation is the square root of the sample variance. It is a measure of the dispersion of the observations in the sample, that is, how far each observation is from the sample mean on the average. Typically, in a sample that has a histogram that resembles a bell-shaped curve, around 68 percent of the observations lie within one standard deviation of the sample mean, and 95 percent of the observations lie within two standard deviations of the sample mean.

Maximum, minimum, and range. The maximum and minimum of the sample are the largest and smallest observations in the sample, respectively. The range is the difference, maximum minus minimum.

Upper and lower quartiles, and interquartile range (IQR). The upper and lower quartiles are defined like the median. One-quarter of the observations in the sample are at least as large as the upper quartile, and three-quarters of the observations are as small or smaller. These fractions are reversed in defining the lower quartile, so that three-quarters of the observations are at least as large as the lower quartile, and one-quarter of the observations are as small or smaller. The interquartile range is the difference, upper quartile minus lower quartile. It is an alternative measure of sample dispersion. When the histogram resembles a bell-shaped curve, the interquartile range is about 1.35 times as large as the standard deviation.

Outliers. Outliers are observations that are exceptionally large or small, so that they appear to be atypical of the majority of observations in the sample. For example, the sample 1 4 3 5 15 contains a single outlier 15. The choice of observations to call outliers is aided by an outlier cutoff rule. For example, using the boxplot rule, an observation is a high outlier if it is more than 1.5 x IQR larger than the upper quartile. There are several alternative outlier cutoff rules, and judgement must play an important role in selecting observations to classify as outliers and then perhaps to remove from the sample. If the sample includes outliers, the sample mean will be pulled towards those observations and the standard deviation will be markedly larger than when the outliers are excluded. The minimum, maximum, and range of the sample are very affected by outliers. The sample median and the interquartile range are not affected by outliers. The sample median and interquartile range are so-called resistant summaries of center and dispersion, respectively. They are thus included in a selection of summary statistics (table 4.4) for their reliability.

Cumulative distribution function. The cumulative distribution function at a given value (of bird weight, for example) is the fraction of observations less than or equal to that value. For example, the cumulative distribution function of the sample 1 3 3 4 is 0 for any value less than 1; is the fraction 1/4 for any value equal to or greater than 1 but less than 3; is the fraction 3/4 for any value equal to or greater than 3 but less than 4; and is 1 for any value equal to or greater than 4.

Kolmogorov-Smirnov two-sample test. The distributions of two samples can be compared using the Kolmogorov-Smirnov test. It is a nonparametric procedure, meaning that a minimum of theoretical assumptions are made about populations underlying the two samples. The Kolmogorov-Smirnov test is based on the largest absolute difference between the two cumulative distribution functions at any value (bird weight). If the difference is large, the two distributions are judged to be different. Tables and statistical algorithms are available to compute P-values and critical values to use in deciding how different the distributions are and whether the difference is significant.

P-value. In statistical testing, it is usual to state a null hypothesis; for example, that there is no difference between two distributions. Of course the two samples are different, but some differences are expected by chance even if each sample is chosen at random from a common pool or population. The P-value is the probability that a difference as large or larger than the observed difference between the two samples will be observed if two samples of the given sizes are drawn from the same population. The largest absolute difference used in the Kolmogorov-Smirnov test is a specific way of measuring the difference between the distributions of two samples. A P-value of 5 percent or lower is commonly interpreted to mean that the observed difference is unlikely to have occurred by chance, so that there is strong evidence for a substantive difference between the two groups. When the P-value is larger than 5 percent, we are more willing to accept the possibility that the two populations are the same. That does not mean that we have proved that they are the same, only that the evidence for a difference is weaker. A P-value around 10 percent can be interpreted as weak evidence that the populations are not the same. A P-value around 40 percent is no evidence at all. A P-value less than 1 percent is very strong evidence.

Critical value. The choice of P-value of 5 percent as a dividing point appears to be based on a historical perception of what is an unlikely event. Other choices are perfectly permissible, for example when we wish to strongly "protect" the null hypothesis, and not declare that there is a difference unless the evidence is very convincing. The critical value is the point at which we make this declaration. For example, it may be the value of the largest absolute difference in the Kolmogorov-Smirnov test when the P-value equals 5 percent. The critical value will depend on the sample sizes involved.

Chi-square test. Counts of events are often arranged in a two-way table, with levels of two factors, for example damage severity and number of birds, represented by the rows and columns, respectively. These factors will be dependent if the proportion of engines with significant damage is larger (or perhaps smaller) among engines ingesting only one bird than among engines ingesting more than one bird. There is a symmetry to these statements: Equivalently we can say that engine events where there is significant damage involve multiple bird ingestions in a disproportionately high fraction of cases (relative to engine events where there is no damage or only minor damage).

When there is no dependence, the row and column factors are said to be independent. When the row and column factors are independent, the typical, or expected, number of observations in a given cell of the two-way table is simply the product of the row and column totals for that cell divided by the overall total. For example, in table 5.2 there are 77 engine events with significant damage, and 305 out of 340 engine events involve only a single bird. Therefore, if damage severity and number of birds were independent, the number of engine events with significant damage where a single bird is ingested would be around 77 x 305/340, or 69 (after rounding). The observed number is 77. As described above, the observed numbers will always differ from the expected numbers, whether or not the two factors are independent. However, larger differences will typically occur when the factors are dependent than when they are independent. (The differences are both positive and negative, since each row total and column total must be the same using either the observed or expected number of observations.) The chi-square statistic is computed by summing the differences over all the cells of the table, specifically using the formula

$$\text{chi-square} = \sum_{\text{all cells}} \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

When the factors are independent, and the expected number of observations in each cell is not too small (at least 5, for example), the chi-square statistic is said to have an approximate chi-square distribution on (r - 1) x (c - 1) degrees of freedom (df), where r and c are the number of rows and columns in the table, respectively. The P-values and critical values are computed based on this distribution (using tables or algorithms) and, as with the Kolmogorov-Smirnov test, are used as evidence for and against the null hypothesis that the differences in the relative proportions between rows (or columns) of the table are due to chance fluctuations alone.

Probability of a difference. When a P-value of, for example, 14 percent is computed for a chi-square test, the claim might be made that the probability that the two factors are dependent is 86 percent. Analogously, when a P-value of 3 percent occurs using the Kolmogorov-Smirnov test, the claim might be made that the probability that the two populations are the same is only 3 percent. The probability that the two populations are different is 97 percent. These claims are justifiable if additional, Baysian, assumptions are made about the data. They give an impression of the weight of evidence, which is the interpretation used above.

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APPENDIX C

SUMMARY OF DATA BASE CONTENTS

This appendix summarizes the contents of the FAA data base used to generate this report. Each line of information pertains to a unique engine ingestion event. The events are ordered chronologically. Unless otherwise specified, "N" denotes "no" or "none" and a "blank" entry means the information is "unknown."

The column headings are defined as follows:

DATE	Date of ingestion
EVT#	Aircraft ingestion event number (repeated in last column)
A/C	Aircraft type
ENG	Engine model
DASH	Engine model dash
POS	Engine position
SIGEVT	Significant Event (SEMB=single engine-multiple bird, MEMB=multiple engine-multiple bird, MESB=multiple engine-single bird, AIRWORTHY, TRVS FRAC=transverse fracture, INVOLPOWLOS=involuntary power loss)
ALT	Altitude of aircraft (feet AGL)
SPD	Speed of aircraft (knots, V1=decision speed, VR=rotation speed, TAXI)
CREW	Crew Action (ATO=aborted takeoff, ATB=air turn back, DIV=diversion, ALT=altitude change)
POF	Phase of flight (TR=takeoff roll, TO=takeoff, TC=takeoff or climb, CL=climb, CR=cruise, DE=descent, AP=approach, LA=landing or approach, LD=landing, LR=landing roll, RV=thrust reverse, TX=taxi)
CITYPRS	Scheduled departure-arrival airports
APT	Airport of ingestion
LOCALE	Location of airport
US	Y=US (50 states), N=Foreign (non-US), U=Unknown
BIRDNAME	Bird species - English name
SPEC	Bird species code (from reference [4])
#BDS	Number of birds ingested
WT	Bird weight (ounces)
POWLOSS	Power loss (100%, 50%, SURGE, STALLS, INVOLUNTARY, Y=yes)
VIBE	Engine vibration (maximum units, INC=increased, HIGH=high)
IFSD	In-flight engine shutdown reasons (SURGE, HI EGT=high exhaust gas temperature, SMELL=bird smell, VIBES=engine vibration, NOT BIRD=IFSD not due to bird, Y=no reason given for IFSD)

In columns A through Q, "Y"=occurrence, "blank"=non-occurrence. Columns A through O represent specific categories of engine damage as defined in table 5.1.

A	LEADEDGE	Fan blade leading edge distortion
B	BEDE<=3	1 to 3 bent or dented fan blades
C	TORN<=3	1 to 3 torn fan blades
D	SHINGLED	Shingled (twisted) fan blades
E	ACPAFNAB	Acoustic panel or fan rub strip damaged
F	NACELLE	Engine enclosure dented or punctured
G	BEDE>3	More than 3 fan blades bent or dented
H	TORN>3	More than 3 fan blades torn
I	BROKEN	Pieces missing from fan blade leading edge or tip
J	TRVSFRAC	Fan blade broken chordwise, piece liberated
K	RELEASED	Blade retention mechanism failed
L	FLANGE	Flange separations
M	CORE	Compressor blades/vanes damaged or airflow blocked
N	TURBINE	Turbine damaged
O	SPINNER	Spinner/cap damaged
P	Other engine damage (see REMARKS)	
Q	Engine damage of unknown type (see REMARKS)	

NMS	Classification of engine damge (0=no damage, 1=minor damage, 2=significant damage)
REMARKS	The Remarks often contain more specific descriptions of engine damage as well as other pertinent information

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DATE	EVT#	A/C	ENG	DASH	POS	SIGEVT	ALT	SPD	CREW	POC	CITYPRS	APT	LOCALE	US	BIRDNAME	SPEC
01/17/89	166	B747	JT9D	70	2	N			N		SIN-OSA	XFO	SINGAPORE OR OSAKA	N		
01/24/89	1	B757	RB211	535C	1	MESB	0		ATB	TR	CDG-LHR	CDG	PARIS-CDG,FRANCE	N	COMMON LAPWING	5R1
01/24/89	1	B757	RB211	535C	2	MESB	0		ATB	TR	CDG-LHR	CDG	PARIS-CDG,FRANCE	N	COMMON LAPWING	5R1
01/29/89	2	B757	RB211	535C4	1	N			N			XFO	GENOA,ITALY?	N		
01/30/89	3	B757	RB211	535E4	2	N			N	LD	-PMI	PMI	PALMA,MALLORCA,SPAIN	N	GULL	
02/17/89	15	B747	JT9D	7R4G2	2	N			N		-NRT	XXX	TOKYO-NRT,JAPAN?	U		
02/23/89	176	B757	2000	2037	2	N			N	CL	MCO-MSP	MCO	ORLANDO,FLORIDA	Y		
02/25/89	111	B757	RB211	535C	1	N			N		-LHR	XFO	LONDON-LHR??	N		
03/11/89	19	DC10	JT9D	59A	1	N	0		N	LR	HND-FUK	FUK	FUKUOKA,JAPAN	N		
03/11/89	165	B747	JT9D	70	3	N			N		AMS-VIE	XFO	AMSTERDAM OR VIENNA	N		
03/12/89	16	B747	JT9D	70A	3	AIRWORTHY			N	CL	NRT-ANC	NRT	TOKYO-NRT,JAPAN	N	COMMON ROCK DOVE	2P1
03/15/89	17	A310	4000	4152	1	SEMD			N	AP	VIE-VIE	VIE	VIENNA,AUSTRIA	N	BLACK-HEADED GULL	1MNJC
03/17/89	4	B757	RB211	535C	2	N			N			XFO	LONDON-LHR??	N		
03/17/89	179	A310	4000	4152	1	N			N			TLS	TOULOUSE,FRANCE	N		
03/18/89	10	B767	4000	4060	1	N	200	150	ATB	CL	MUC-FAD	MUC	MUNICH,GERMANY	N	COMMON LAPWING	5R1
03/18/89	28	B767	4000	4060	1	N	0		ATB	TR	MUC-ATH	MUC	MUNICH,GERMANY	N		
03/22/89	20	DC10	JT9D	59A	3	N					FUK-HND	XFO	FUKUOKA OR TOKYO-HND,JAPAN	N		
03/31/89	167	B747	JT9D	70	2	N			N		SIN-ADL	XFO	SINGAPORE OR ADELAIDE	N	"SEA GULL"	
04/01/89	5	B757	RB211	535E4	1	N	150	135	N	TO	LHR-MAN	LHR	LONDON-LHR,ENGLAND,UK	N	"MEDIUM WHITE"	
04/03/89	6	B757	RB211	535E4	2	N			N		AGP-AMS	XFO	MALAGA OR AMSTERDAM	N		
04/04/89	21	B757	2000	2037	2	N	0	150	N	TR	MEM-MSP	MEM	MEMPHIS,TENN.	Y	AMERICAN ROBIN	[illegible]
04/12/89	22	B747	JT9D	7R4G2	1	N	0	130	ATO	TR	WDH-ABJ	WDH	WINDHOEK,NAMIBIA	N		
04/15/89	23	B767	JT9D	7R4D	2	N					SFO-SFO	SFO	SAN FRANCISCO,CAL.	Y	BLACK-CROWNED NITE HERON	1I24
04/17/89	26	B747	JT9D	70	4	N			N		SEL-NRT	XFO	SEOUL,KOREA OR TOKYO-NRT	N		
04/18/89	24	B767	JT9D	7R4D	1	MESB			N		FUK-HND	XFO	FUKUOKA OR TOKYO-HND,JAPAN	N	LITTLE BROWN BAT	BAT
04/18/89	24	B767	JT9D	7R4D	2	MESB			N		FUK-HND	XFO	FUKUOKA OR TOKYO-HND,JAPAN	N	LITTLE BROWN BAT	BAT
04/19/89	25	B747	JT9D	70	3	N			N		YVR-NRT	XFO	VANCOUVER OR TOKYO-NRT	N	COMMON ROCK DOVE	2P1
04/20/89	7	B757	RB211	535E4	2	N	0		DIV	TR	HAM-LPA	HAM	HAMBURG,GERMANY	N	"GULL"	
04/25/89	30	B747	JT9D	70	2	N			N		TYO-OSA	XFO	TOKYO-TYO OR OSAKA,JAPAN	N		
04/29/89	27	A310	JT9D	7R4E1	2	N			N	AP	-BRU	BRU	BRUSSELS,BELGIUM	N	COMMON ROCK DOVE	2P1
05/02/89	160	B747	JT9D	7R4G2	2	SEMD			N		SIN-	XXX		U		
05/04/89	31	B767	JT9D	7R4D	2	SEMD	0	100	N	TR	HND-	HND	TOKYO-HND,JAPAN	N	GRAY-HEADED LAPWING	5R20
05/10/89	32	A300	JT9D	59A	1	SEMD,ENGOLPWRLOS	0	VR	ATO	TR	BCN-MAD	BCN	BARCELONA,SPAIN	N	HERRING GULL	1MN14
05/14/89	33	A300	JT9D	7R4H1	1	N	0	V1	N	TR	KRT-JED	KRT	KHARTOUM,SUDAN	N	RING-NECKED DOVE	2P61
05/17/89	8	B757	RB211	535E4	1	N	1000	135	N	AP	AMS-PMI	PMI	PALMA,MALLORCA,SPAIN	N	COMMON SAND MARTIN	1022[illegible]
05/24/89	9	B757	RB211	535C	2	N	0		N	LR	IST-IST	IST	ISTANBUL,TURKEY	N	"GULL"	
05/28/89	10	B757	RB211	535C	1	N			N		FCO-LHR	XFO	ROME OR LONDON-LHR	N		
06/02/89	169	B747	JT9D	7R4G2	1	N	0	100	ATO	TR	BOM-SIN	BOM	BOMBAY,INDIA	N		
06/03/89	34	A310	4000	4152	1	N	0	100	ATO	TR	PEN-SIN	PEN	PENANG,MALAYSIA	N	"FISH EAGLE	
06/07/89	35	B767	JT9D	7R4D	2	N			N		SPK-NGO	XFO	SAPPORO OR NAGOYA,JAPAN	N		
06/[illegible]/89	36	B767	JT9D	7R4D	1	N	1000		N	AP	NGO-SPK	SPK	SAPPORO,JAPAN	N	FORK-TAILED SWIFT	1070
06/[illegible]/89	4[illegible]	A320	V2500	A1	1	N			N	AP	-ZRH	ZRH	ZURICH,SWITZERLAND	N		
06/[illegible]/89	11	B757	RB211	535E4	1	N	0	1[illegible]0	ATO	TR	VCE-LGW	VCE	VENICE,ITALY	N	"SEAGULL"	
06/14/89	1[illegible]	B757	RB211	535C	1	N			N	LD	[illegible]-LGW	LGW	LONDON-GATWICK,ENGLAND,UK	N		
06/16/89	1[illegible]	A320	V2500	A1	1	N			N		BEG-LJU	BEG	BELGRADE,YUGOSLAVIA	N	EURASIAN KESTREL	5K[illegible]
06/18/89	[illegible]	[illegible]	JT9D	7R4G[illegible]	[illegible]	AIRWORTHY			DIV	CL	SPK-HND	SPK	SAPPORO,JAPAN	N	BLACK KITE	[illegible]
06/[illegible]/89	40	B747	JT9D	70	1	N			N	AP	[illegible]-ANC	ANC	ANCHORAGE,ALASKA	Y		
06/24/89	4[illegible]	DC10	JT9D	59A	1	N	0		N	LR	OSA-OKA	OKA	OKINAWA,JAPAN	N	"SMALL BIRDS"	
07/01/89	6[illegible]	[illegible]	CF6	80C2	2	N	0		N	LR	-TOY	TOY	TOYAMA,JAPAN	N		
07/0[illegible]/89	1[illegible]	B757	RB211	535E4	2	N	0		N	TL	TLV-FCO	TLV	TEL AVIV,ISRAEL	N		
07/0[illegible]/89	4[illegible]	B767	JT9D	7R4D	2	N	0		N	LR	FUK-OKA	FUK	FUKUOKA,JAPAN	N	COMMON ROCK DOVE	2P1
07/0[illegible]/89	1[illegible]	A310	4000	4152	1	N	15		[illegible]	TO	PEN-SIN	PEN	PENANG,MALAYSIA	N	"1 LARGE BIRD"	
07/04/89	3[illegible]	A320	V2500	A1	2	N		1[illegible]0	N	AP	DEL-BOM	BOM	BOMBAY,INDIA	N	"EAGLE"	
07/0[illegible]/89	1[illegible]	B757	2000	2037	2	N	[illegible]		N	[illegible]		XXX		Y		
07/1[illegible]/89	1[illegible]	B757	RB211	535C	2	N	0	1[illegible]0	N	LR	LHR-GVA	GVA	GENEVA,SWITZERLAND	N	GREATER KESTREL	5K[illegible]
07/12/89	4[illegible]	A320	V2500	A1	2	N	0	40	N	RV	LJU-TIV	TIV	TIVAT,YUGOSLAVIA	N	HERRING GULL	1MN1[illegible]
07/1[illegible]/89	4[illegible]	A310	CF6	80C2	1	N			N		-MEL	XFO	MELBOURNE,AUSTRALIA	N		
07/1[illegible]/89	[illegible]	B767	CF6	80C2	2	N			N			XFO	JAPAN	N		
07/1[illegible]/89	[illegible]	B747	JT9D	7R4G2	1	N			N	LD	-CDG	CDG	PARIS-CDG,FRANCE	N		
07/1[illegible]/89	[illegible]	B767	CF6	80A	1	N			N	AP	-NGO	NGO	NAGOYA,JAPAN	N		
07/1[illegible]/89	[illegible]	A320	V2500	A1	1	N			N	[illegible]	BEG-LJU	LJU	LJUBLJANA,YUGOSLAVIA	N	EURASIAN KESTREL	5K[illegible]

BIRDNAME	SPEC	#BDS	WT	PWRLOSS	VIBE	IFSD	ABCDE	FGHIJ	KLMNO	PQ	NHS	REMARKS	EVT#
		1		N		N					0		166
OMMON LAPWING	5N1	1	8	N	N	N					0	BIRD MATTER ON NOSE COWL,OUTSIDE OF FAN	1
OMMON LAPWING	5N1	1	8		4.7	N	YY Y	Y			1	#2 ENG VIBR DUE TO CLAPPER LOCKUP	1
		1		N	N	N	YY				1	DMG BLD FOUND ON GRD INSP AT BAH	2
ULL		1		N	N	N					0	BLOOD ON BLD TIPS FOUND ON GROUND INSP	3
				N		N					0	HPC BSCOPED. NO DMG FOUND	15
				STALLS		N					0	2 AUDIBLE STALLS, FLAMES FROM TAILPIPE	176
		1		N	N	N			Y		2	1 IPC BL BE/DE	111
				N			Y				1	1 FB BENT AT TIP	19
		1		N		N					0		165
OMMON ROCK DOVE	2P1	1	14	N	INC	N	Y	Y Y			2	10 PR FB REPLCD,127 COWL RIVETS FRACTRD	16
LACK-HEADED GULL	14NJG	3	10	N		N					0	TRAINING FLIGHT	17
				N	N	N					0		4
						N					0	VIBES EXISTED PRIOR TO BIRDSTRIKE	173
OMMON LAPWING	5N1	1	7.7	N		N			Y		0	SURGE,FLAMES.LTU SUD INT'L.ENG REMVD.	18
				N		N					0	LTU SUD INTL	20
											0	C6 LE BL DENTS NOT CAUSED BY BIRD INGSTN	20
SEA GULL"		1		N		N					0	2 OTHER A/C STRIKES	167
MEDIUM WHITE"		1		N	N	N	Y				1	1 FB LE DEFLECTION	5
		1		N	N	N					0	BLOOD STAINS UPPER OUTER SIDE OF INTAKE	6
MERICAN ROBIN	412314	1	2.5			N	Y Y	Y			2	FAN CASE STRUT DMG.THUD.1FB BROKEN.	21
		1		SURGE		SURGE					0	LOUD BANG(SURGE)	22
LACK-CROWNED NITE HERON	1124	1	24					Y			2	TRNG FLT.5 FB BE.	23
		1		N		N					0	BLOOD ON INLET LIP	26
LITLE BROWN BAT	BAT	1	0.5	N		N					0	UNRELATED HPC DMG.ENG REMVD.	24
ITLE BROWN BAT	BAT	1	0.5	N		N					0	WHEN,WHERE UNKNOWN	24
MMON ROCK DOVE	2P1	1	14	N		N					0	MAINT. FOUND BIRD REMAINS IN INLET	25
ULL"				N	1.9	N	Y Y				1	DIV TO MUC AT END OF CLIMB	7
		1		N		N					0	BLOOD FOUND IN TOKYO PRE-DEPART CHECK	30
MMON ROCK DOVE	2P1		14	N		N					0	BIRD RMNS.ON FB'S	27
		>1		N		N					0	SQ FLT #447 SPINNER HIT	168
Y-HEADED LAPWING	5N20	3	10	N		N					0	SMALL WHITE BIRDS-TBI	31
RING GULL	14N14	3	36	100%,SURGE		HI EGT	Y		Y Y		2	EPR=0,HI EGT,SURGE,VIDEO TAPE	32
NG NECKED DOVE	2P61		5	N		N	Y				1	2 PR FB REPLACED	33
MMON SAND MARTIN	18229	1	16	N	N	N					0	STRIKE ON OUTSIDE OF COWL	8
[illegible]		1		N	N	N		Y		Y	1	LINING DMG AFT OF FAN	9
				N	N	N				Y	1	1 FB CLAPPER DMGED	10
		1		SURGE		N					0		169
[illegible] EAGLE		1		SURGE		N					0	SURGE,NO BIRD REMAINS	34
				N		N					0	BD.REMNS.FD ON GRD AT NAGOYA-SPINNR,FEGV	35
[illegible] TAILED SWIFT	1070	1	1.5			N					0	FOUND ON WALKAROUND	36
						N					0	INLET COWL HIT.NO INGESTION EVIDENCE	42
[illegible] GULL"		1		N	4.0	N	Y YY				1	2 FB SHNGLD, TIP DMG	11
				N	N	N		Y	Y		2	1 IPC BL BE/DE	12
[illegible]ICAN KESTREL	5N27		7	N	N	N					0	BDSTRIKE EVIDENCE FOUND ON WALKAROUND	37
[illegible] KITE	5G78	1	32			N	Y	Y			2	12 FB BE.PLANNED ALT WAS CHANGED.	39
						N					0	BIRD RMNS IN GUIDE VANES	40
[illegible] HERONS"						N					0	FLOCK OF SMALL BIRDS	44
		1		N		N			Y		2	6 HPC BLDS DMGD	69
		1		N	N	N					0	FLT CONTINUED NORMALLY.UNWHLDTD 80z WT	13
[illegible] ROCK DOVE	2P1		14			N					0	BRD REMNS FAN EXIT GUIDE VANES	41
[illegible] BIRD"		1		N		N	Y q				1	1 FB DMGD. HPC BLS MINOR NICKS	170
[illegible]		1		N		N	YY Y				1	2FBL,FAN CASE PANEL.PASSNGR SAW 6LB EAGLE	38
				N	INC	N	Y				1	IFSD?? 1-2 FB BE	177
[illegible]ER KESTREL	5N24	1	[illegible]	N	N	N			Y		2	4 IPC BL BENT.HI IDLE=58% FAN SPEED	14
[illegible]ING GULL	14N14	1	[illegible]	N		N					0	A/C AT FULL THRUST REVERSE,"1/2 BIRD"	43
		1		N	N	N					0	PREFLIGHT INSP.	49
		1		N		N					0	GROUND INSP.	70
						N					0		45
		1				N	Y				1	2 FB BENT	55
[illegible]ICAN KESTREL	5N27		7	N		N	Y				1	DMG FN CASE PANEL CONTINUE IN SERVICE	46

DATE	EVT#	A/C	ENG	DASH	POS	SIGEVT	ALT	SPD	CREW	POF	CITYPRS	APT	LOCALE	US	BIRDNAME	SPEC	#BDS	HT
07/16/89	71	B767	CF6	80C2	1	N	0		ATB	AP	-MAO	MAO	MANUS,BRAZIL	N			1	
07/19/89	72	B767	CF6	80C2	?	SEMB	0		N	TR	HIJ-TYO	HIJ	HIROSHIMA,JAPAN	N			2	
07/20/89	175	A310	4000	4152	1	N			N			XFO	SINGAPORE?	N				
07/21/89	50	A320	CFM56	5	1	N			N	LD	-DUS	DUS	DUSSELDORF,GERMANY	N			1	
07/24/89	29	B757	RB211	535E4	2	N			N		IVT-DUS	XFO	DUSSELDORF OR MADAGASCAR	N	EURASIAN KESTREL	5K27	1	7.2
07/24/89	117	B747	JT9D	7R4G2	1	N			N	AP	NRT-SVO	SVO	MOSCOW-SHEREMETYE,USSR	N			1	
07/25/89	140	A320	V2500	A1	1	SEMB	0	135	ATO	TR	TLS-TLS	TLS	TOULOUSE,FRANCE	N			2	
07/29/89	178	B767	JT9D	7R4D	1	N	0		N	LR	-TLV	TLV	TEL AVIV,ISRAEL	N				
08/02/89	118	A320	V2500	A1	1	N	3500	250	ATB	CL	DEL-BLR	DEL	DELHI,INDIA	N	INDIAN WHT-BCKD VULTURE	5K46	1	19.
08/02/89	120	B757	2000	2037	2	N			N		DTW-	XUS	DETROIT, MICHIGAN??	Y	AMERICAN KESTREL	5K26	1	
08/03/89	51	A320	CFM56	5	1	N			N		-LHR	XFO	LONDON,ENGLAND?	N			1	
08/03/89	121	B767	4000	4060	1	N	0	85	DIV	TR	GRQ-DUS	GRQ	GRONINGEN,NETHERLANDS	N	RED-LEGGED PARTRIDGE	4141	1	10
08/05/89	122	DC10	JT9D	59A	3	N	0		N	TR	PEK-OSA	PEK	BEIJING,CHINA	N	GRAY HEADED LAPWING	5N20	1	10
08/06/89	123	B767	4000	4060	2	N	300	145	N	AP	MDA-MUC	MUC	MUNICH,GERMANY	N	BLACK-HEADED GULL	14N36	1	10
08/06/89	124	B747	JT9D	70	4	N	1800		N	CL	DEL-FLO	DEL	DELHI,INDIA	N			1	
08/07/89	47	B757	RB211	535C	1	N			N		LHR-BFS	XFO	LONDON-LHR OR BELFAST	N			1	
08/07/89	125	DC10	JT9D	59A	1	N			N		NRT-BKK	XFO	TOKYO-NRT OR BANGKOK	N	WHT-THT'D NDLE-TLD SWIFT	107	1	
08/08/89	73	B767	CF6	80C2	2	N			N		-TYO	XFO	TOKYO-TYO,JAPAN?	N			1	
08/09/89	126	B747	JT9D	70	4	N			N		-NRT	XFO	TOKYO-NRT??	N	COMMON SKYLARK	17272	1	
08/10/89	127	B767	JT9D	7R4D	2	N			N		YYZ-YVZ	XFO	TORONTO---DEER LAKE,CANADA	N			1	
08/11/89	52	A320	CFM56	5	2	N			N	AP	-DUS	DUS	DUSSELDORF,GERMANY	N		TBI	1	
08/13/89	56	B767	CF6	80A	1	N	0	120	ATO	TR	LGW-	LGW	LONDON-GATWICK,ENGLAND,UK	N			1	
08/13/89	74	A310	CF6	80C2	2	SEMB	0		ATB	TR	PIK-GHX	PIK	PRESTWICK,SCOTLAND,UK	N	HERRING GULL	14N14	2	4
08/14/89	75	B767	CF6	80C2	1	TRVS FRAC	200		ATB	CL	GRU-	GRU	SAO PAULO,BRAZIL	N	BLACK VULTURE	1K4	1	4
08/15/89	130	B747	JT9D	70	4	N			N			XXX		U	BLACK-HEADED GULL	14N36	1	
08/16/89	57	B767	CF6	80A	1	N			N		-OSA	XFO	OSAKA,JAPAN?	N			1	
08/16/89	129	DC10	JT9D	59A	3	N			N	AP	HND-SPK	SPK	SAPPORO,JAPAN	N	BLACK KITE	3K28	1	
08/10/89	76	A310	CF6	80C2	1	N			N	CL	MBA-	MBA	MOMBASA,KENYA	N			1	
08/18/89	128	B747	JT9D	7R4G2	2	N	0		ATO	TR	ORD-NRT	ORD	CHICAGO,ILLINOIS	Y	"GULL"		1	
08/18/89	131	B757	2000	2037	1	N			N		CAN-SHA	XFO	GUANGZHOU/SHANGHAI,CHINA	N				
08/20/89	174	B757	2000	2037	1	N			N			XUS		Y				
08/21/89	50	B767	CF6	80A	1	N	0		N	LR	-OSA	OSA	OSHKA,JAPAN	N			1	
08/21/89	179	B767	JT9D	7R4D	2	N			N			XUS		Y				
08/25/89	77	A310	CF6	80C2	2	N			N		-YEG	XFO	EDMONTON,CANADA?	N			1	
08/28/89	78	B767	CF6	80C2	2	N			N		-LAX	XUS	LOS ANGELES,CA?	Y			1	
08/28/89	79	B767	CF6	80C2	1	N	0		N	LR	-KUH	KUH	KUSHIRO,INDIA	N			1	
08/29/89	132	B767	JT9D	7R4D	1	N	0		N	TR	NRT-	NRT	TOKYO-NRT,JAPAN	N				
08/30/89	53	A320	CFM56	5	1	N	0	VR	ATB	TR	BRU-LHR	BRU	BRUSSELS,BELGIUM	N	CARRION CROW	22294	1	1
08/31/89	59	B767	CF6	80A	2	N			N		-OSA	XFO	OSAKA,JAPAN?	N			1	
08/31/89	135	B757	2000	2037	2	N			N		CAN-SHA	XFO	GUANGZHOU/SHANGHAI,CHINA	N				
08/31/89	142	B767	JT9D	7R4D	2	N			N	AP	NGO-HND	HND	TOKYO-HND,JAPAN	N	BLACK-CROWNED NITE HERON	1124	1	2
08/31/89	171	B747	4000	4056	3	MEMB	0		N	LR	PAE-PAE	PAE	EVERETT,WASHINGTON	Y	"SMALL BIRDS"		>1	
08/31/89	171	B747	4000	4056	4	MEMB	0		N	LR	PAE-PAE	PAE	EVERETT,WASHINGTON	Y	"SMALL BIRDS"		>1	
08/31/89	172	A300	JT9D	59A	1	N			ATB	TC		XFO		N				
09/01/89	134	B747	JT9D	70	3	N			N		BAH-BKK	XFO	BAHRAIN OR BANGKOK	N				
09/05/89	60	B767	CF6	80A	1	N			N	AP	-SDJ	SDJ	SENDAI,JAPAN	N			1	
09/05/89	141	A320	V2500	A1	1	N	0	145	N	TR	DEL-HYD	DEL	DELHI,INDIA	N	"LARGE KITE"		1	
09/06/89	135	B757	2000	2037	1	N			N		CAN-SHA	XFO	GUANGZHOU/SHANGHAI,CHINA	N				
09/07/89	136	B747	4000	4056	3	N	0		N	LR	PAE-PAE	PAE	EVERETT,WASHINGTON	Y	COMMON NIGHT HAWK	5T5	1	
09/09/89	61	B767	CF6	80A	2	N			N	LD	-TOY	TOY	TOYAMA,JAPAN	N	"BAT"		1	
09/10/89	62	A310	CF6	80A	1	N	0	V1	N	TR	AMS-	AMS	AMSTERDAM,NETHERLANDS	N			1	
09/10/89	137	B747	JT9D	7R4G2	2	N			N		LHR-ANC	XXX	LONDON-LHR OR ANCHORAGE	U	HORNED LARK	17271		1
09/11/89	80	A310	CF6	80C2	2	N			N		-DEL	XFO	DELHI,INDIA?	N			1	
09/12/89	63	A310	CF6	80A	1	N			N		-AMS	XFO	AMSTERDAM, NETHERLANDS?	N			1	
09/12/89	64	A310	CF6	80A	1	N			N		-MIL	XFO	MILAN,ITALY?	N			1	
09/12/89	138	B747	JT9D	70	1	MEMB,TRVS FRAC	0	170	ATB	TR	LAX-OSA	LAX	LOS ANGELES,CAL.	Y	COMMON ROCK DOVE	2P1	4	11
09/12/89	138	B747	JT9D	70	2	MEMB,TRVS FRAC	0	170	ATB	TR	LAX-OSA	LAX	LOS ANGELES,CAL.	Y	COMMON ROCK DOVE	2P1	>4	11
09/13/89	139	B747	JT9D	7R4G2	3	N			N		MNL-BKK	XFO	MANILA OR BANGKOK	N	SCHRENCK'S BITTERN	1I9	1	
09/15/89	54	A320	CFM56	5	2	N	0	V1	N	TR	FRA-LGW	FRA	FRANKFURT,GERMANY	N			1	
09/17/89	48	B757	RB211	535C	1	N	0	140	ATB	TR	BFS-LHR	BFS	BELFAST,N.IRELAND,UK	N	COMMON LAPWING	5N1	1	
09/17/89	81	B767	CF6	80C2	1	N	0		N	TR	MYJ-TYO	MYJ	MATSUYAMA,JAPAN	N			1	

NAME	SPEC	#BDS	WT	PWRLOSS	VIBE	IFSD	ABCDE:FGHIJ:KLMNO:PQ:NMS	REMARKS	EVT#
		1		N	5.0	N	: Y : : : :	1 ATB ON SUCCEEDING FLIGHT	71
		2		N		N	:Y YY: Y : Y : :	2 2HPC STG 1 BLDS,6 FB DMGD. ENG REMOVED	72
				N		N	: Y: : : :	1 RUBSTRIP BROKEN	175
		1		N		N	: : : : :	0 FRESH BIRD STAINS AFTER LANDING	50
IAN KESTREL	5K27	1	7.2	N	N	N	: : : : :	0 GROUND INSP.	29
		1				N	: : : : :	0 AGB HOUSNG CRACKED	117
		2		N		SHELL	: Y: : : :	1 1 SMALL & 1 LARGE BIRD, NOSE PANEL CRACK	140
				N		N	: : : : :	2 9TH STG CORE DAMAGE??	178
N WHT-BCKD VULTURE	3K46	1	192		INC	N	: Y: YY : : Y:	2 6 FB BE.VOL.PWR RED-VIBES.COWL DMG.	118
CAN KESTREL	5K26	1	4	N		N	:YY : : : :	1 1 FB LE DENT INOD SHROUD	120
		1		N		N	: : : : :	0 GROUND INSP. LHR	51
EGGED PARTRIDGE	4I41	1	16	N		N	: : : : :	0 2D STRK THIS ENG-3/18/89.SPINNER HIT.	121
HEADED LAPWING	5N20	1	10	N		N	: : : : :	0 SPINNER HIT	122
-HEADED GULL	14N36	1	10	N		N	: : : : :	0 HIT NOSE COWL, ING INFO CORE	123
		1		N	INC	N	: :Y Y : : Y:	2 5FB DMGD, 4FB REPAIRED LOUD THUD	124
		1		N	N	N	: : : Y : :	2 20 STG1 IPC BL SLITE TIP CURL WITH LIMIT	47
HI'D HOLE-TLD SWIFT	107	1	3	N		N	: : : : :	0 BIRD INTO CORE	125
		1		N		N	: : : : :	0 BSI OK	73
N SKYLARK	17272	1	2	N		N	: : : : :	0 FEATHERS AT STGS 3 & 7.5 BLEED SCREEN	126
		1		N		N	: Y : : : :	1 1 FB BOWED 1/4"	127
	TBI	1				N	: : : : :	0 FEATHERS SENT TO AIR FRANCE	52
		1			5.0	N	:Y YY: : : :	2 5FB,3AC.LINERS DMGD.DARK BIRD	56
NG GULL	14N14	2	40		INC	N	: YY: Y : Y : :	2 19 FB DMGD,HPC BL DMG SERVICEABLE	74
VULTURE	1K4	1	48	50%	5.0	VIBES	: Y :Y Y: : :	2 1 FB FAILED 3 IN ABOVE MIDSPAN SHROUD	75
-HEADED GULL	14N36	1	10	N		N	: : : : :	0 BIRD,RMNS IN LPC. ENG DISASSEMBLED	130
		1		N		N	: : : : :	0 GROUND INSP.	57
KITE	3K28	1	32	N		N	: : : : :	0 FINAL AP. BIRD RMNS ON FEGV	129
		1			HIGH	VIBES	:Y : : :Y :	1 3 FB LE,1 OGV DELAMINATED	76
"		1		N		N	: : : : :	0 FEATHER ON FEGV	128
				N		N	: : : : :	0 TO BE SCOPED.CORE DMG?	131
				N		N	: Y : : : :	1 1 FB BE.FLT # NW 1191	174
		1		N		N	: Y : Y : Y : :	2 HPC STG 1 BLDS DMGD SERVICEABLE LIMITS	58
				N		N	: : : : :	0 BIRD HIT NOSE COWL	173
		1		N		N	: Y : : : :	1 1 BE FB.GROUND INSP.	77
		1		N		N	: : : : :	0 GROUND INSP.	78
		1				N	: : : : :	0	79
				N		N	: : : : :	0	13?
N CROW	22294	1	19	N	9.6	N	:Y YY: Y : Y : :	2 22FB DMGD.COMP DMG SERVICEABLE	53
		1		N		N	: : : : :	0 GROUND INSP.	59
				N		N	: : : : Y:	1 2 FB DMG WITHIN LIMITS	133
CROWNED NITE HERON	1124	1	24	N		N	: : : : :	0 TIP NICK BLENDED OUT.CORE ING.	142
BIRDS"		>1		N		N	: : : : :	0 TRAINING FLIGHT	171
BIRDS"		>1		N		N	: : : : :	0 HIT ON SPINNER	171
				SURGE		N	: : Y : : :	2 1 BL BROKEN	172
				N		N	: Y: Y : : :	2 2FB PIECES MISSING.3FB DMG.COWL HIT.	134
		1		N		N	: Y: : :Y :	1 10 OGV OUTER FAIRINGS,3 AC LINRS REPLCD	60
KITE"		1		N	INC	N	: Y : : : :	1 3FB BE.FAN CASE FAIRING HOLE.CORE ING.	141
				N		N	: : : : :	0 SAME A/C AS 133 & 131.	135
NIGHT HAWK	515	1	9	N		N	: : : : :	0 BOEING OWNED.TO BE DELVD KE.SPINNER HIT.	136
		1		N		N	: : : Y : :	2 6 BLS DMGD IN STG 5&6 COMPRESSOR	61
		1		N		N	: Y : : : :	1 2 BE FB 15 MM FROM TIP	62
LARK	17274		1.5	N		N	: : : : :	0 ANC=ANCHORAGE, ALASKA.BIRD INTO CORE.	137
		1		N		N	: : : : :	0 GROUND INSP.	80
		1		N		N	: Y : : : :	1 1 FB TIP CURL	63
		1		N		N	: Y : : : :	1 1 FB TIP CURL,GROUND INSP	64
ROCK DOVE	2P1	4	14	SURGE		N	: Y:YY Y : : :	2 INLET COWL PEN. BY FB PIECE.5FB DMG.	138
ROCK DOVE	2P1	>4	14	INVOLUNTARY	INC	SURGE,HIEGT	: Y: Y Y: : :	2 NONRECOV STALL,TAIL CONE LIBRTED,7BL DMG	138
KS BITTERN	1I9	1	3	N		N	: : : : :	0	139
		1		N	3.3	N	: Y : : : :	1 VIBR.3.3UN CLIMB,2 CRUISE,1.2 IDLE	54
LAPWING	5N1	1	8	N	2.2	N	:Y Y: YYY : : :	2 5 FB BE/DE,14 TURN,3 BROKEN,ENG.CHANGED	48
		1		N		N	: : : : :	0	81

DATE	EVT#	A/C	ENG	DASH	POS	SIGEVT	ALT	SPD	CREW	POF	CITYPRS	APT	LOCALE	US	BIRDNAME	SPEC	$BU
09/19/89	65	B767	CF6	80A	1	N			N		-SHI	XFO	SHIMOJISHIMA,JAPAN?	N			
09/20/89	82	A310	CF6	80C2	1	N			N	CL	BJL-DKR	BJL	BANJUL,GAMBIA	N			
09/22/89	143	DC10	JT9D	59A	3	N	100		N	CL		XFO		N	"LARGE SNOWY HERON"		
09/23/89	144	A300	4000	4158	1	N			N	TC	PUS-SEL	XFO	PUSAN OR SEOUL,KOREA	N			
09/23/89	234	A310	4000	4152	2	N						XFO		N			
09/24/89	66	B767	CF6	80A	1	N			N	AP	-OKA	OKA	OKINAWA,JAPAN	N			
09/25/89	145	B767	JT9D	7R4D	2	N			N	TC	FUK-HND	FUK	FUKUOKA,JAPAN	N			
09/27/89	67	B767	CF6	80A	2	N			N		-OSA	XFO	OSAKA,JAPAN?	N			
09/27/89	146	B747	4000	4056	4	N			N			XXX		U			
09/28/89	68	B767	CF6	80A	2	N	0	130	ATO	TR	JFK-	JFK	NEW YORK-JFK,NY	Y	HERRING GULL	14N14	
09/28/89	83	B747	CF6	80C2	2	N			N		-RIO	XFO	RIOGRANDE,BRAZIL?	N	BLACK-CROWNED NITE HERON	1I24	
09/29/89	147	B747	JT9D	70	1	N			N		VVR-SEL	XFO	VANCOUVER OR SEOUL	N			
10/01/89	88	B767	CF6	80A	2	N	0		N	LR	-KCZ	KCZ	KOCHI,JAPAN	N			
10/01/89	98	B747	CF6	80C2	3	N	0		N	LR	AMS-JFK	JFK	NEW YORK-JFK,NY	Y	RING-NECKED PHEASANT	4L161	
10/01/89	148	B747	4000	4056	3	N			N			XFO		N	COMMON BARN OWL	152	
10/04/89	151	B767	4000	4060	1	SEMB			N			XXX		U			
10/06/89	149	B757	2000	2040	2	N			N	AP	ALB-PIE	PIE	ST.PETERSBURGH,FLA.	Y			
10/07/89	112	B757	RB211	535C	1	MESB	832	135	N	LD	LHR-BSL	BSL	BASEL,SWITZERLAND	N			
10/07/89	112	B757	RB211	535C	2	MESB	832	135	N	LD	LHR-BSL	BSL	BASEL,SWITZERLAND	N			
10/07/89	150	B767	4000	4060	1	SEMB			N		CPH-CAI	XFO	COPENHAGEN OR CAIRO	N	SENEGAL COUCAL	2R127	
10/10/89	113	B757	RB211	535E4	2	N			N	LD	-KTM	KTM	KATHMANDU,NEPAL	N			
10/12/89	99	B767	CF6	80C2	2	N			N		-OSA	XFO	OSAKA,JAPAN?	N			
10/12/89	152	B767	JT9D	7R4D	1	MEMB	0	125	ATO	TR	TLV-CDG	TLV	TEL AVIV,ISRAEL	N	CHUKAR	4L37	
10/12/89	152	B767	JT9D	7R4D	2	MEMB	0	125	ATO	TR	TLV-CDG	TLV	TEL AVIV,ISRAEL	N	CHUKAR	4L37	
10/16/89	100	B767	CF6	80C2	1	N	0		N	LR	-OSA	OSA	OSAKA,JAPAN	N			
10/16/89	101	A310	CF6	80C2	1	N			N	AP	-IST	IST	ISTANBUL,TURKEY	N	SMALL BLACK		
10/16/89	114	B757	RB211	535E4	2	N	600	120	N	LD	DCA-ORD	ORD	CHICAGO,ILLINOIS	Y	RING-BILLED GULL	14N12	
10/16/89	153	B747	JT9D	7R4G2	2	N			N		FUK-HND	XFO	FUKUOKA OR TOKYO-HND,JAPAN	N	BLACK-TAILED GULL	14N10	
10/16/89	154	B747	JT9D	7R4G2	2	U			N		CTS-HND	XFO	SAPPORO OR TOKYO-HND,JAPAN	N			
10/19/89	155	B767	4000	4060	1	SEMB	0		N	LR	-HER	HER	HERAKLION,GREECE	N	HORNED LARK	17274	
10/21/89	84	A320	CFM56	5	1	N	0		N	LR	-CDG	CDG	PARIS-CDG,FRANCE	N			
10/21/89	102	B747	CF6	80C2	3	MESB	50	170	N	CL	HAM-	HAM	HAMBURG,GERMANY	N			
10/21/89	102	B747	CF6	80C2	4	MESB	50	170	N	CL	HAM-	HAM	HAMBURG,GERMANY	N			
10/22/89	89	B767	CF6	80A	1	N			N		-DUS	XXX	DUSSELDORF,GERMANY?	U			
10/23/89	103	A310	CF6	80C2	1	SEMB,IRVS FRAC	0	147	ATO	TR	AMM-	AMM	AMMAN,JORDAN	N	EURASIAN STONE CURLEW	6NF	
10/24/89	90	B767	CF6	80A	1	N	0		N	LR	TYO-KCZ	KCZ	KOCHI,JAPAN	N			
10/25/89	91	B767	CF6	80A	1	N			N	AP	-OKJ	OKJ	OKAYAMA,JAPAN	N			
10/26/89	104	B767	CF6	80C2	1	N			N		-MRU	XFO	MAURITIUS,MAURITIUS?	N	COMMON BARN OWL	152	
10/27/89	164	B767	4000	4060	1	N			N			XFO		N			
10/28/89	92	A310	CF6	80A	1	N	900		N	TO	CDG-LIN	CDG	PARIS-CDG,FRANCE	N			
10/29/89	156	B747	JT9D	7R4G2	1	N			N	AP	-HND	HND	TOKYO-HND,JAPAN	N			
10/29/89	157	A310	4000	4152	1	N			N	TO	HAM-JFK	HAM	HAMBURG,GERMANY	N			
11/02/89	119	B767	JT9D	7R4D	1	N	150		N	AP	HKG-KIJ	KIJ	NIGATA,JAPAN	N		TBI	
11/02/89	158	B767	JT9D	7R4D	1	SEMB			N	AP	TLV-ETH	ETH	ELAT,ISRAEL	N	"PIGEON"	TBI	
11/04/89	93	B767	CF6	80A	2	N			N	AP	-TYO	TYO	TOKYO-TYO,JAPAN	N			
11/07/89	105	A310	CF6	80C2	2	N	0		N	LR	-CDG	CDG	PARIS-CDG,FRANCE	N	"SMALL BIRD"		
11/08/89	106	A310	CF6	80C2	2	N			N		-BOM	XFO	BOMBAY,INDIA?	N			
11/11/89	94	B767	CF6	80A	1	N			N		-OSA	XFO	OSAKA,JAPAN?	N			
11/11/89	159	B747	JT9D	7R4G2	3	U	0	145	ATB	TR	IST-SIN	IST	ISTANBUL,TURKEY	N		TBI	
11/15/89	95	A310	CF6	80A	1	N	50	V1+	ATO	CL	AMS-AMS	AMS	AMSTERDAM,NETHERLANDS	N			
11/15/89	160	B767	4000	4060		N			N		EWR-ARN	XXX	NEWARK OR STOCKHOLM	U			
11/16/89	107	A310	CF6	80C2	2	N	17000		N	CL	TRV-BOM	TRV	TRIVANDRUM,INDIA	N			
11/18/89	115	B757	RB211	535C	2	SEMB	0	121	N	LR	LHR-BFS	BFS	BELFAST,N.IRELAND,UK	N	COMMON LAPWING	5N1	
11/20/89	161	B767	JT9D	7R4D	2	N			N	AP	-LAX	LAX	LOS ANGELES,CAL.	Y		TBI	
11/21/89	85	A320	CFM56	5	1	MESB			N		-CDG	XFO	PARIS-CDG,FRANCE?	N			
11/21/89	85	A320	CFM56	5	2	MESB			N		-CDG	XFO	PARIS-CDG,FRANCE?	N			
11/25/89	162	A300	JT9D	7R4H1	1	N			N		KWI-CAI	XFO	KUWAIT OR CAIRO	N		TBI	
11/26/89	108	A300	CF6	80C2	1	N	0		ATB	TR	KHI-	KHI	KARACHI,PAKISTAN	N			
12/03/89	96	B767	CF6	80A	1	N			N		-BHX	XFO	BAHIA BLANCA,ARGENTINA?	N			
12/04/89	245	B747	JT9D	7R4G	1	N	0	125	N	RV	OSA-SIN	SIN	SINGAPORE	N	"VERY LARGE SEAGULL"		
12/06/89	163	A300	JT9D	7R4H1	1	N		VR	N	TO	-JED	JED	JEDDAH,SAUDI ARABIA	N	COMMON ROCK DOVE	7P1	

NAME	SPEC	#BDS	WT	POWLOSS	VIBE	IFSD	ABCDE	FGHIJ	KLMNO	PQ	NHS	REMARKS	EVT#
		1		N		N			Y		2	1 STG 1 HPC BL TIP MISSG,5 STGG BL TEARS	65
		1		N		N					0	SM-MED BIRD INTO CORE	82
E: SNOWY HERON"		1		N		N	Y	Y			2	5 BL BE LE. FLT #960	143
		1		N		N	Y				1	3 FB BE.TO/CL	144
							Y				1	2 FB LE TIP CURL.RPLCD.	234
		1		N		N					0	DESCENT/APPROACH	66
		1		N		N					0	TO/CL	145
		1		N		N			Y		2	4 HPC STG 7 BLS DMGD.PREFLITE INSP.	67
		1		N		N	YY				1	1 FB LE CURL	146
IG GULL	14N14	1	40	N		N	Y		Y		2	BROKEN STG 1 HPC BLDS.ENG REMOVED	68
-CROWNED NITE HERON	1I24	1	24			N	Y		Y		2	1 STG 1 COMP BL DMGD.ENG REMOVED	83
				N		N	YY				1	2 FB LE DEF.	147
		1		N		N				Y	2	6 FB DMGD & RPLCD.	88
NECKED PHEASANT	4L161	1	40	N		N	Y				1	3 FB LE DE FORMED	98
4 BARN OWL	152	1	11	N		N	Y				1	2 FB PRS RPLCD.WALKAROUND.	148
		>1		N		N					0	SEVERAL BDS HIT COWL	151
		1		N		N			Y		2	1 6 STG HPC BL. DMGD	149
		1		N	0.9	N					0	FAN SPD 73%.MANY STRIKES A/C,ENGINES	112
		1		N	0.9	N					0	FAN SPD 74%.MANY STRIKES A/C,ENGINES	112
IL COUCAL	2R127	>1	7	N		N					0	BIRD ID IMPLIES CAIRO??	150
		1		N		N					0		113
		1		N		N			Y		2	HPC STG 1 & 8 DMG.. NO FB DMG	99
:	4L37	>1	18	SURGE		N					0	BIRDS IN COMP.INVESTIGATED.	152
:	4L37	>1	18	SURGE		N	Y				1	1 FB BE. BIRDS IN COMP.INVESTIGATED.	152
		1		N		N					0	NO CORE INGESTION	100
BLACK		1		N		N	Y				1	2 FB SHINGLD AT PART SPAN SHRDS.	101
ILLED GULL	14N12	1	17	N		N					0		114
TAILED GULL	14N10	1	21	N		N	Y				1	2 fb be	153
		>=1		N		N					0	POSS MULT BIRD	154
LARK	17274	>1	2	N		N					0	CORE ING.	155
		1		N		N					0	T25 SENSOR REPLACED DUE TO BIRD DEBRIS	84
		1		N		N	Y Y	Y			2	2 FB LE DISTOR, 1 FB LE CRACK	102
		1		N		N	Y				1	4 FB LE DISTORTION	102
		1		N		N				Y	1	2 FB DMGD	89
AN STONE CURLEW	6N7	2	16	50%	10.0	N		YYYYY			2	POSSIBLE HARD FOD. 2 FB SEPARATED	103
		1		N		N	Y				1	2 FB SHINGLED	90
		1		N		N					0		91
BARN OWL	152	1	11	N		N					0		104
				N		N					0	BD RMNS IN CORE	164
		1		N	N	N					1	3 FB DDOR AT 1000FT AGL.	92
		1		N		N					0		156
		1		N		N					0	MULT BIRD? ING. INTO CORE.HIT FLOCK?	157
	TBI	1		N		N			Y		2	5TH STG LE TIPS CLASHED TE IGV'S.ENG RMD	119
R"	TBI	2		N		N					0	INVSTGTD	158
		1		N		N	Y			Y	2	5FB SINGLRD, 12 FB REPLACE BD	93
BIRD"		1		N	N	N					0	BSI ON #10 #2 RMGS. NO TRACES IN #1	105
		1		N		N	Y				1	4 FB NON-SERUCALR LE DMG	106
		1		N	N	N					0	GROUND INSP.	94
	TBI	>1		Y	HIGH	N	Y	Y			2	INVSTGTD.POSS MULT BD, AIRWTHY 9FB DMG	159
		1		N		N	Y			Y	1	3FB DMGD, 2FB SHINGLED, 3 SETS REPLCD.	95
						N	YY				1	1 BL DMGD	160
		1		N	2.6	N	Y				1	? FB IMPACT DMG. VIBE 1.4 UNITS AT CRUIS	107
LAPWING	5N1	4	8	N	1.4	N			Y		2	8 IPC BL BE.13 BDS HIT A/C.INVST.ENG RPL	115
	TBI			N		N					0	# BDS?	161
		1		N		N					0	FEATHERS FOUND, NOT GIVEN TO GE.ENG #04	85
		1		N		N					0	PROB.SMALL BIRD,DESC/LD/AP POF	85
	TBI	1		N		N	Y				1	3 FB DMGD	162
		1		N	INC	N				Y	2	4 DMGD FB REPLCD- INC N1 VIBES	108
		1		N	N	N	4				1	2 FB DMED OUTBD MD SPANSHROU	96
RGE SEAGULL"		1				N					0	REVERSER LOCKED OUT.DAMAGE??	245
ROCK DOVE	2P1	1	14	SURGE		N	Y	Y			2	2 FB SEVERE DMG.TOUCH & GO(VR)	153

DATE	EVT#	A/C	ENG	DASH	POS	SIGEVT	ALT	SPD	CREW	POF	CITYPRS	APT	LOCALE	US	BIRDNAME	SPEC	#BDS
12/13/89	86	A320	CFM56	5	2	N			N		-SAN	XUS	SAN DIEGO,CAL.	Y			1
12/14/89	97	A310	CF6	80A	1	NEMB	0		N	LR	ANK-IST	IST	ISTANBUL,TURKEY	N	BLACK-HEADED GULL	14N36	6-17
12/14/89	97	A310	CF6	80A	2	NEMB	0		N	LR	ANK-IST	IST	ISTANBUL,TURKEY	N	BLACK-HEADED GULL	14N36	6-17
12/15/89	221	B747	JT9D	7Q	1	N			N		TPE-BKK	XFO	TAIWAN OR THAILAND	N			
12/19/89	216	A310	JT9D	7R4	2	N	0		ATB	TR	BRU-	BRU	BRUSSELS,BELGIUM	N	COMMON LAPWING	5N1	1
12/19/89	220	A300	JT9D	7R4H	1	N	0		N	LR	MED-JED	JED	JEDDAH,SAUDI ARABIA	N			
12/20/89	109	B767	CF6	80C2	2	N			N	LD	-TYO	TYO	TOKYO-TYO,JAPAN	N			1
12/23/89	110	A310	CF6	80C2	2	N			N		-MBA	XFO	MOMBASA,KENYA?	N			1
12/28/89	116	B757	RB211	535C	2	SEMB	800	150	DIV	TO	BFS-LHR	BFS	BELFAST,N.IRELAND,UK	N	COMMON LAPWING	5N1	1
12/31/89	87	A320	CFM56	5	1	N	0		N	LR	-LYS	LYS	LYON,FRANCE	N			1
01/01/90	215	B767	4000	4056	2	N	0	80	ATO	TR	HRE-LGW	HRE	HARARE,ZIMBABWE	N	AFRICAN EAGLE OWL	2544	1
01/01/90	218	A310	4000	4158		N			N			XFO	KOREA OR INDONESIA	N		TBI	1
01/02/90	191	B747	CF6	80C2	2	N	0		N	LR	-HKG	HKG	HONG KONG	N			1
01/09/90	192	A310	CF6	80C2	1	N			N	LD	-LCA	LCA	LARNACA,CYPRUS	N			1
01/14/90	184	B767	CF6	80A	1	SEMB	0		N	LR	-LTN	LTN	LONDON-LUTON,ENGLAND,UK	N	HUNGARIAN PARTRIDGE	4L85	[illegible]
01/15/90	219	B767	JT9D	7R4	1	SEMB	300	145	N	AP	HND-SPK	SPK	SAPPORO,JAPAN	N	COMMON POCHARD	2J115	[illegible]
01/16/90	193	A310	CF6	80C2	1	NESB			N		-DLA	XFO	DOUALA, CAMEROON ???	N			1
01/16/90	193	A310	CF6	80C2	2	NESB			N		-DLA	XFO	DOUALA, CAMEROON ???	N			1
01/18/90	194	A310	CF6	80C2	2	N			N	LD	-SXF	SXF	E.BERLIN,GERMANY	N	"CROW"?		1
01/24/90	195	B767	CF6	80C2	1	N	0		N	LR	-IGU	IGU	IGUASSA FALLS,BRAZIL	N			1
01/28/90	185	A310	CF6	80A	2	N			ATB	CL	ANK-	ANK	ANKARA,TURKEY	N			1
01/28/90	196	A300	CF6	80C2	2	N			N		BKK-CNX	XFO	THAILAND	N			1
01/29/90	197	B767	CF6	80C2	2	N			N		-YYZ	XFO	TORONTO,CANADA ??	N			1
01/30/90	180	A320	CFM56	5	2	N	0		ATB	CL	CDG-	CDG	PARIS-CDG,FRANCE	N		TBI	1
02/02/90	186	B767	CF6	80A	1	N			N		-MYJ	XFO	MATSUYAMA, JAPAN ??	N			1
02/08/90	222	B767	JT9D	7R4D	2	N			N		TLV-CDG	XFO	TEL AVIV OR PARIS-CDG	N			
02/09/90	244	A310	JT9D	7R4E	1	NESB			N		SIN-CMB	XFO	SINGAPORE/COLOMBO,SRILANKA	N			
02/09/90	244	A310	JT9D	7R4E	2	NESB			N		SIN-CMB	XFO	SINGAPORE/COLOMBO,SRILANKA	N			
02/10/90	198	B747	CF6	80C2	1	N	0		N	LR	-JKT	JKT	JAKARTA,INDONESIA	N			1
02/11/90	187	B767	CF6	80A	2	N			N		-JFK	XUS	NEW YORK-JFK,NY ???	Y			1
02/11/90	226	B747	4000	4056	2	SEMB			N		LAX-SYD	XXX	LOS ANGELES/SYDNEY,AUSTRLA	U			1
02/11/90	243	A310	JT9D	7R4E	2	N	1340	130	N	AP	KTM-CCU	CCU	CALCUTTA,INDIA	N	"BIG HAWK"		1
02/12/90	199	B767	CF6	80C2	2	N			N		-OSA	XFO	OSAKA,JAPAN ???	N			1
02/12/90	224	DC10	JT9D	59H	3	N			N		NRT-BKK	XFO	TOKYO-NRT OR BANGKOK	N	COMMON SNIPE	6N47	1
02/13/90	181	A320	CFM56	5	1	N			N		BRE-FRA	XFO	BREMEN/FRANKFURT,GERMANY	N		TBI	1
02/13/90	227	A310	JT9D	7R4E	2	N					-BRU	XFO	BRUSSELS,BELGIUM??	N	MALLARD DUCK	2J84	1
02/14/90	182	A320	CFM56	5	1	N	0		N	LR	-TLS	TLS	TOULOUSE,FRANCE	N			1
02/14/90	251	A300	JT9D	59A	1	N	0		N	TR	DPS-	DPS	DENPASAR,BALI	N			1
02/18/90	200	B747	CF6	80C2	4	N	0		N	LR	-AMS	AMS	AMSTERDAM,NETHERLANDS	N			1
02/19/90	188	B767	CF6	80A	1	N			N		-	XFO	BRAZIL?	N	BLACK VULTURE	1K4	1
02/21/90	201	B767	CF6	80C2	1	NESB	0	V1	ATB	TR	AMS-	AMS	AMSTERDAM,NETHERLANDS	N	COMMON LAPWING	5N1	1
02/21/90	201	B767	CF6	80C2	2	NESB	0	V1	ATB	TR	AMS-	AMS	AMSTERDAM,NETHERLANDS	N	COMMON LAPWING	5N1	1
02/21/90	225	B767	JT9D	7R4D	1	NEMB	800		N	AP	OSA-HND	HND	TOKYO-HND,JAPAN	N	GREATER SCAUP	2J124	1
02/21/90	225	B767	JT9D	7R4D	2	NEMB	800		N	AP	OSA-HND	HND	TOKYO-HND,JAPAN	N	GREATER SCAUP	2J124	1
02/24/90	223	A300	JT9D	7R4H	1	N	0	VR	ATB	TR	NBO-JED	NBO	NAIROBI,KENYA	N	HELMETED GUINEA FOWL	5L3	1
02/26/90	202	B767	CF6	80C2	2	N	0		N	LR	-SHJ	SHJ	SHARJAH,UA EMIRATES	N			1
02/27/90	206	A310	CF6	80C2	2	N		V1+	ATB	TO	SXF-	SXF	E.BERLIN,GERMANY	N	HUNGARIAN PARTRIDGE	4L85	1
03/02/90	228	B757	2000	2037	2	N			N		ATL-MSY	XUS	ATLANTA OR NEW ORLEANS	Y			1
03/04/90	203	B767	CF6	80C2	2	N			N		-AXT	XFO	AKITA,JAPAN ???	N			1
03/05/90	183	A320	CFM56	5	2	N	0	120	N	TR	LST-MEL	LST	LAUNCESTON,AUSTRALIA	N	"PLOVER"	TBI	1
03/05/90	189	B767	CF6	80A	1	N			N		-OKJ	XFO	OKAYAMA, JAPAN ??	N			
03/07/90	204	B747	CF6	80C2	3	N	0		N	LR	JFK-AMS	AMS	AMSTERDAM,NETHERLANDS	N	RING-NECKED PHEASANT	4L161	
03/09/90	229	B767	4000	4056	1	N	0	70	N	LR	HRE-NBO	NBO	NAIROBI,KENYA	N	BLACK KITE	3K78	1
03/16/90	230	A300	JT9D	7R4H1	1	N			N		RUH-JED	XFO	RIYADH OR JEDDAH, S.ARABIA	N			1
03/16/90	231	A300	JT9D	7R4H	2	N		144	N	CL	DHA-RUH	DHA	DHAHRAN,SAUDI ARABIA	N	HERRING GULL	14N14	1
03/17/90	207	B757	RB211	535C	1	N			N		LHR-MAN	XFO	LONDON-LHR/MANCHESTER,ENG.	N	"SMALL"		1
03/24/90	190	B767	CF6	80A	1	N			N		-TYO	XFO	TOKYO-TYO,JAPAN ???	N			1
03/24/90	232	B747	JT9D	7Q	3	N	0		N	TR	BUE-RIO	BUE	BUENOS AIRES,ARGENTINA	N			
03/26/90	205	A310	CF6	80C2	2	N			N		-FRA	XFO	FRANKFURT,GERMANY ??	N			1
04/02/90	276	A310	CF6	80A	2	N			N	AP	-SHJ	SHJ	SHARJAH,UA EMIRATES	N			1
04/04/90	233	B767	JT9D	7R4D	1	N	300		N	AP	HND-SPK	SPK	SAPPORO,JAPAN	N			1

NAME	SPEC	#BDS	WT	POWLOSS	VIBE	IFSD	ABCDE	FGHIJ	KLMNO	PQ	NMS	REMARKS	EVT#
		1		N		N					0		86
-HEADED GULL	14N36	6-17	10	N		N	Y			Y	1	20 FB SHNGLD, 1FB BLENDABLE	97
-HEADED GULL	14N36	6-17	10	N		N					0	HIT IMMED.AFTER TOUCHDOWN.OVER 100HIT AC	97
				N		N					0	EVIDENCE FOUND IN INLET ON GROUND	221
I LAPWING	5N1	1	7.7			N	Y	YY Y			2	INV.4FB BE,2FB BKN.14FB DMG.ALL FB RPLCD	216
											0	POWER AT REVERSE IDLE	220
		1		N	N	N	Y	YY	Y		2	7 FB DMGD, STG 1 CMP BLS. TORN	109
		1		N		N					0	SLIGHT FB DMG WITHIN LIMITS	110
LAPWING	5N1	3	8	N	4.6	N	YY	Y	Y		2	4FB,15IPC BL BE/DE.INVESTGTD	116
		1		N		N	YYY				1		87
N EAGLE OWL	2544	1	26								0	BANG,SHELL,FLAMES,SURGE.VOL POWER RED.	215
	TBI	1									0	FOUND DURING OVERHAUL.INTO CORE.ENG DMG?	218
		1		N	5.0	N	Y				1	1 FB LE DISTORTION	191
		1		N	N	N					0	DENT ON INLET COWL LIP GRD INSP	192
IAN PARTRIDGE	4L85	2	14	N	N	N	YY Y				1	3 FB RPLCE.LE DENT, TIP CURL.	184
POCHARD	2J115	2	35				YY	Y Y	Y		2	BENT C5 BLD PREVIOUS STRIKE EVIDENCE	219
		1		N		N					0	PREFLITE INSP AT OLA	193
		1		N		N					0	PREFLITE INSP AT OLA	193
?		1		N	N	N					0	STAIN ON SPINNER, BOOSTER INLET.	194
		1		N	N	N					0	ING.INTO BOOSTER AREA	195
		1		N	3.5	N	Y Y				1	2 FB LE DISTORT	185
		1		N	N	N					0		196
		1		N		N					0	GRD. INSP.	197
	TBI	1		N		N	Y			Y	1	8 OGV FAIRNGS DWN. 5 PR FB RPLCD	180
		1		N		N					0	EVDNCE FOUND GRD.INSP.	186
				N		N	Y				1	2 FB BE	222
											0	WALK AROUND.ZULU TIME.	244
											0	WALK AROUND.ZULU TIME.	244
		1		N		N					0		198
		1		N		N				Y	1	1 FB RPLCD	187
		>1					Y				1	3 FB DMGD	226
AWK"		1									0		243
		1		N	N	N					0	GRD. INSP.	199
SNIPE	6N47	1	5			N					0	GRD INSP.C1 STATOR HIT	224
	TBI	1		N	N	N					0	ODOR ON PREVIOUS FLIGHT	181
D DUCK	2J84	1	40								0	BIRD INTO CORE.WALKAROUND.	227
		1		N		N					0		182
		1					Y				1	3 FB BE	251
		1		N	4.1	N				Y	2	11 DMG FB	200
VULTURE	1K4	1	48	N		N			Y		2	12 HPC STG 1 BL DMGD.ENG RPLCD.	188
LAPWING	5N1	1	7.7	N		N	Y				1	3 FB TIP CURL	201
LAPWING	5N1	1	7.7	N	3.2	N	Y				1		201
R SCAUP	2J124	>1	36					Y			2	BENT 5-8 BLADES MULTI-BIRD??	225
R SCAUP	2J124	1	36								0		225
D GUINEA FOWL	5L3	1	52		2.0	N	Y Y	Y Y		Y	2	SHELL, BANG.5FB LE TIP BRKN,FEGV BRKN	223
		1		N		N					0		202
AN PARTRIDGE	4L85	1	14	N	2.8	N	YY				1	1FB TORN, 1FB DISTORTED	206
		1		N		N	Y	Y			2	3 FB DMG, 1 LE TIP BRK OUT	228
		1		N		N			Y	Y	2	3 STG 1 COMP BL SHIFTED--SERVICEABLE	203
?'	TBI	1		N	9.4	N	YY	Y			2	20 FB DMG.ENG RMVD.1 FB TIP FRAG.	183
		1		N		N					0	FD.GROUND INSP.	189
CKED PHEASANT	4L161	1	32	N		N	Y				1	3 FB LE DISTORT-RPLCD	204
ITE	3K28	1	28	N		N	Y				1	STRONG SMELL.1 BL BE.	229
		1						Y			1	DENTED COWL LIP.WALK AROUND.	230
GULL	14N14	1	40		HIGH	N		D Y			2	INLET COWL: 46 HOLES. 2 FB BRK.OUT	231
		1		N	N	N					0	BIRD MATTER DOWN BYPASS DUCT	207
		1		N		N					0	FD. GRD INSECT	190
				N		N	Y	Y			2	AT CRUISE AVM 1.5.7 FB DMG, 3FB BRKN	232
		1		N		N					0	GRD INSP	205
		1		N		N	Y			Y	2	16FB DMG BEYOND LIMITS.SHROUD LINERS DMGD	276
		1									0	BD INTO CORE.	239

DATE	EVT#	A/C	ENG	DASH	POS	SIGEVT	ALT	SPD	CREW	POF	CITYPRS	APT	LOCALE	US	BIRDNAME	SPEC	THR
04/06/90	265	A320	CFM56	5	2	SEMB		137	N		LIL-LIL	LIL	LILLE,FRANCE	N	"DOVES"		
04/06/90	277	B767	CF6	80A	1	N			N		-ARB	XFO	ARLANDA,SWEDEN??	N			1
04/06/90	292	B767	CF6	80C2	2	SEMB	10		N	LD	-WAW	WAW	WARSAW,POLAND	N	BLACK-HEADED GULL	14N06	1
04/09/90	270	A310	CF6	80A	1	N	0		N	LR	-DUS	DUS	DUSSELDORF,GERMANY	N			1
04/11/90	293	B767	CF6	80C2	2	N			N		LAX-YVR	XXX	LOS ANGELES OR VANCOUVER	U			1
04/12/90	266	A320	CFM56	5	2	N			N	CL	LHR-DUS	LHR	LONDON-LHR,ENGLAND,UK	N			1
04/13/90	235	B757	2000	2037	2	N			N	AP	MSP-DCA	DCA	WASHINGTON-NATIONAL,DC	Y	OSPREY	2K1	1
04/16/90	279	B767	CF6	80A	1	N			N		-FUK	XFO	FUKUOKA, JAPAN???	N			1
04/16/90	294	B747	CF6	80C2	2	N	0		N	LR	YOW-AMS	AMS	AMSTERDAM,NETHERLANDS	N	RING-NECKED PHEASANT	4L161	1
04/16/90	295	B767	CF6	80C2	1	N			N		-TYO	XFO	TOKYO-TYO,JAPAN???	N			1
04/16/90	296	B767	CF6	80C2	2	N			N		-TYO	XFO	TOKYO-TYO,JAPAN???	N			1
04/17/90	208	B747	RB211	524G	3	N			N	LD	PAE-PAE	PAE	EVERETT,WASHINGTON	Y	CANADA GOOSE	2J30	1
04/18/90	297	B767	CF6	80C2	1	N	0	V1+	ATB	TR	ORY-JFK	ORY	PARIS-ORLY,FRANCE	N			1
04/19/90	298	B767	CF6	80C2	1	N	1000		N	AP	YVR-YYZ	YYZ	TORONTO,CANADA	N			1
04/19/90	299	A310	CF6	80C2	2	N	0	V1+	ATB	TR	AYT-	AYT	ANTALYA,TURKEY	N	EGYPTIAN VULTURE	3K43	1
04/23/90	280	B767	CF6	80A	2	N			N		-TYO	XFO	TOKYO-TYO,JAPAN???	N			1
04/25/90	300	B747	CF6	80C2	4	N			N		HND-FUK	XFO	TOKYO-HND OR FUKUOKA,JAPAN	N	COMMON SKYLARK	17222	1
04/26/90	301	B767	CF6	80C2	1	N			N		-MYJ	XFO	MATSUYAMA,JAPAN??	N			1
04/26/90	302	A310	CF6	80C2	1	N			N		SXF-PFO	XFO	E.BERLIN OR CYPRUS	N			1
04/30/90	236	A310	4000	4152	1	N	0		N	TX	BNE-POM	BNE	BRISBANE,AUSTRALIA	N	"HAWK"		1
05/02/90	258	A310	4000	4152	2	N			N		-TPA	XUS	TAMPA,ST. PETE ??	Y			1
05/02/90	281	B767	CF6	80A	1	N			N		-TOY	XFO	TOYAMA,JAPAN ??	N			1
05/02/90	303	A310	CF6	80C2	2	N	0		N	LR	-EBB	EBB	ENTEBBE,UGANDA	N	AFRICAN FISH EAGLE	3K??	
05/03/90	259	B747	4000	4056	3	N			N	CL	TPE-HKG	TPE	TAIPEI,TAIWAN	N			1
05/03/90	304	A310	CF6	80C2	2	N	0		N	LR	-LBA	LBA	LEEDS-BRADFORD,ENGLAND,UK	N	"GULL"		1
05/04/90	267	A320	CFM56	5	1	N	0	V1+	ATB	TR	LIL-	LIL	LILLE,FRANCE	N			1
05/05/90	305	A300	CF6	80C2	1	N			N		-BKK	XFO	BANGKOK,THAILAND??	N			1
05/08/90	282	B767	CF6	80A	1	N			N	AP	-MYJ	MYJ	MATSUYAMA,JAPAN	N			1
05/09/90	237	B767	JT9D	7R4D	2	N			N	AP	NRT-NGO	NGO	NAGOYA,JAPAN	N	LITTLE BROWN BAT	BAT	1
05/10/90	306	B767	CF6	80C2	1	N			N	AP	-TOY	TOY	TOYAMA,JAPAN	N			1
05/11/90	283	B767	CF6	80A	1	N			N		-OSA	XFO	OSAKA,JAPAN ???	N			1
05/12/90	249					N						XFO		N	BLACK KITE	3K28	
05/13/90	239	B767	4000	4060	1	N			N			XFO		N	JAR FALCON	5K??	1
05/15/90	209	B757	RB211	535E4	2	N			N		TFS-AMS	XFO	TENERIFE OR AMSTERDAM	N			
05/17/90	284	A310	CF6	80A	2	N			N		-STR	XFO	STUTTGART,GERMANY ??	N			1
05/18/90	285	A310	CF6	80A	1	N	0		N	LR	LHR-LCA	LCA	LARNACA,CYPRUS	N	COMMON LAPWING	5H1	1
05/20/90	307	B747	CF6	80C2	4	N			N		-GIG	XFO	RIO DE JANEIRO, BRAZIL??	N			1
05/22/90	210	B757	RB211	535E4	1	N			N	LD	-KEV	KEV	KEFLAVICK,ICELAND	N	"LARGE"		1
05/23/90	268	A320	CFM56	5	1	SEMB	0	V1+	N	TR	SYD-MEL	SYD	SYDNEY,AUSTRALIA	N			1
05/26/90	240	B767	JT9D	7R4D	2	N	0	120	N	TR	SHI-	SHI	SHIMOJISHIMA,JAPAN	N	LITTLE EGRET	1150	1
05/27/90	211	B757	RB211	535E4	1	N	13000		N	CR		XXX	MEXICO OR TEXAS	U			
05/29/90	308	B767	CF6	80C2	2	N			N		-NGS	XFO	NAGASAKI,JAPAN??	N			1
05/30/90	309	A310	CF6	80C2	1	N			N	CL	MGQ-	MGQ	MISKOLC,HUNGARY	N			1
05/31/90	247	A300	JT9D	59A	1	INVOLPWRLOS	0	VR	ATO	TR	IBZ-	IBZ	IBIZIA,SPAIN	N	HERRING GULL	14N14	1
05/31/90	250	B767	JT9D	7R4E	1	P			N	CL	AKL-SYD	AKL	AUCKLAND,NEW ZEALAND	N			
06/01/90	238	B767	4000	4056	1	N	0			TR	LIM-SCL	LIM	LIMA,PERU	N	"SMALL SEAGULL"		1
06/04/90	310	A300	CF6	80C2	2	N			N		-LTN	XFO	LONDON-LUTON,ENGLAND??	N			1
06/07/90	269	A320	CFM56	5	1	N			N		-MSP	XUS	MINNEAPOLIS??	Y			1
06/07/90	311	B767	CF6	80C2	2	N			N	AP	-KCZ	KCZ	KOCHI,JAPAN	N			1
06/07/90	312	A310	CF6	80C2	1	N	0		N	LR	-LCA	LCA	LARNACA,CYPRUS	N	CHUKAR	4L37	1
06/08/90	313	B767	CF6	80C2	2	N			N		-OSA	XFO	OSAKA,JAPAN???	N			1
06/09/90	212	B757	RB211	535C	2	N			N		-MAN	XFO	MANCHESTER,ENG ???	N			
06/09/90	270	A320	CFM56	5	2	N	0	V1	ATO	TR	BSL-LHR	BSL	BASEL,SWITZERLAND	N			
06/10/90	271	A320	CFM56	5	1	N	0		N	LR	-RMA	RMA	ROMA,AUSTRALIA	N			1
06/11/90	286	B767	CF6	80A	1	N			N		-TAK	XFO	TAKAMATSU,JAPAN ??	N			1
06/12/90	272	A320	CFM56	5	1	N	0	V1+	ATO	TR	LYS-BOD	LYS	LYON,FRANCE	N		1H1	1
06/12/90	314	A300	CF6	80C2	1	N	100	140	N	LD	PEK-SHA	SHA	SHANGHAI,CHINA	N	COMMON ROCK DOVE	2P1	1
06/13/90	213	B757	RB211	535E4	1	N			N		MLA-MUC	XFO	MALTA OR MUNICH	N			1
06/13/90	287	B767	CF6	80A	1	N	0		N	LR	-SDJ	SDJ	SENDAI,JAPAN	N			1
06/14/90	273	A320	CFM56	5	2	SEMB			N		-MEL	XFO	MELBOURNE,AUSTRALIA??	N	"SMALL"		1
06/17/90	214	B757	RB211	535E4	1	MEMB	30	110	N	LD	-BOS	BOS	BOSTON,MASS.	Y	HERRING GULL	14N14	1

DS	BIRDNAME	SPEC	#BDS	WT	POWLOSS	VIBE	IFSD	ABCDE	FGHIJ	KLMNO	PQ	NMS	REMARKS	EVT#
N	"DOVES"		2		N	9.9	N				Y	2	7FB DMG,14FB RPLCD.TO OR LD?UNVAL B&2HT	265
N			1		N		N					0	EVIDENCE ON HP STATOR VANES.GRD INSP	277
N	BLACK-HEADED GULL	14N06	>1	10	N		N					0	DEBRIS ON ALL FB.MIDSPAN CORE ING	292
N			1		N		N					0		278
U			[illegible]		N		N					0	DEBRIS IN BOOSTER & COMP INLET.GRD INSP.	293
N			1		N	5.9	N	Y Y				1	2 FB DE, 8 FB RPLCD	266
Y	OSPREY	2K1	1	55					Y			2	6 SETS FB RPLCD.	235
N			1		N		N					0	GROUND INSP	279
N	RING-NECKED PHEASANT	4L161	1	54	N		N					0	NO CORE ING	294
N			1		N		N						GRD INSP.	295
N			1		N		N					0	GRD INSP	296
Y	CANADA GOOSE	2J30	1	128	N	N	N			Y		2	16 HPC BL BE-NOT SOFT BODY PRE DLVRY	208
N			1		N		N	Y			Y	1	3FB DMGD. 2 PR FB RPLCD.	297
N			1		N		N					0	BIRD ING. INTO CORE	298
N	EGYPTIAN VULTURE	3K43	1	75	N	2.6	N	Y	Y		YY	2	ALL FB RPL,MIN DMG INLETCOWL,ACOU.PANEL	299
N			1		N		N					0	GROUND INSP	280
N	COMMON SKYLARK	17272	1	1.5	N		N					0	DEBRIS ON COWL,FB'S,SPINNER,PRIM.GASPATH	300
N			1		N		N	YY				1	1 FB WITH DE & AXIAL CRACK RPLCD.	301
N			1		N		N					0	GRD INSP AT PHAPHOS,CYPRUS	302
N	"HAWK"		1					Y	Y			1	TAXI OUT. 1FB NICKED.FAIRING DELAM	236
[illegible]			1		N		N	Y				1	2 FB LE BE. WALKAROUND	258
N			1		N		N					0	HIT FAN OGV'S & INLET COWL LIP.GRD INSP.	281
N	AFRICAN FISH EAGLE	3K27	1	100	N	3.4	N	Y			Y	1	VIBES ON SUBS.FLITE. 5FB RPLD,3FB SHGLD.	303
N			1			4.9	N	Y				1	3 FB BE. BANG. NO SURGE. PARAMETER SHIFT	259
N	"GULL"		1		N		N					0	AT TOUCHDOWN	304
[illegible]			1		N	INC	Y	Y				1	3 PR FB RPLCD LE DISTORTION	267
[illegible]			1		N		N	Y				1	FB#11 DE & REPAIRED	305
N			1		N		N			Y		2	STG 1 HPC BL BE DE	282
[illegible]	LITTLE BROWN BAT	BAT	1	0.3		N	N					0	BAT HIT COWL.	237
[illegible]			1		N		N					0	BIRD HIT FB'S, OGV, LPC IGV'S	306
[illegible]			1		N		N					0	GRD. INSP	283
[illegible]	BLACK KITE	3K28		28									SHOP FINDING. LITTLE DATA. DAMAGED??	249
	BAT FALCON	[illegible]K27	1	46.4								0		239
[illegible]					N	N	N			Y		2	SPINNER RUBBER TIP DMGD	209
			1		N		N					0	BLOOD IN CORE INLET.GRD INSP.	284
[illegible]	COMMON LAPWING	5N1	1	7.7	N		N	Y				1	2 FB RPLCD	285
[illegible]			1		N		N					0	GRD INSP	307
	"LARGE"		1		N	N	N					0	HEAVY DEBRIS IN BY-PASS "LG"BD	210
			2		N	INC	N	Y		Y	Y	2	5FBDMGD,2FBLE TEARS.2 SPINNER CONESRPLCD	260
	LITTLE EGRET	[illegible]	[illegible]	17								0	DATA NOT ON REPORT	248
					N	N	N					0	MEXICAN GOVT A/C	211
			1		N		N					0	GRD. INSP.	308
			1		N	3.4	N				Y	2	4 FB DMGD BEYOND LIMITS	309
[illegible]	[illegible]RING GULL	14N14	1	40	INVOLUNTARY	INC	HIEGT,VIBES			Y	Y	2	FUEL DUMPED.SURGE.DAMAGED?CONTAINED?	247
	"SMALL SEAGULL"		1		N							0	INTO CORE	250
			1		N		N					0	SHELL. 8-12 OZ.SEAGULL.	238
			1		N		N					0	GRD INSP. NO CORE ING.	310
			1		N	1.9	N			Y	Y	2	SLITE HPCOTHSTGVANE YIELDING.5OGVSPACERS	269
	[illegible]	4L37	1	18	N		N	Y				1	3 FB SHINGLED-REPLCD.	311
			1		N		N					0	BIRD HIT MIDSPAN SHROUD AREA	312
			1		N	N	N					0	CORE ING.	313
			1		N		N			Y		2	UNK. ... BL DMG. ENG RMVD	212
			1		N		N				Y	2	17 FB DMGD, REPLCD	270
			1		N		N					0	ALL ENG PARAMS NORMAL	271
		1P1	1		N	6.0	N					0	BIRD HIT SPINNER.GRD INSP	286
	[illegible] DOVE	2P1	1	14	N		N		Y		Y	2	7 FB SEVERE DMG,DEFORM.SHRDSSPRFB RPLCD	272
			1		N	N	N					0	BIRD ENTERED BOOSTER,EXITED VBV DOOR	314
			1		N		N					0	DEBRIS FOUND GROUND INSP.	213
	"SMALL"		[illegible]		N		N					0	BIRDS HIT ENG, COCKPIT CABIN FLOCK????	287
	HERRING GULL	[illegible]	>1	[illegible]	N	N	N	Y				1	VIBES ON SUBSEQUENT FLITES.FAN SET RPLCD	273
												0	DEBRIS DOWN BY-PASS	214

DATE	EVT#	A/C	ENG	DASH	POS	SIGEVT	ALT	SPD	CREW	POF	CITYPRS	APT	LOCALE	US	BIRDNAME	SPEC	#BL
06/17/90	214	B757	RB211	535E4	2	MEMB	30	110	N	LD	-BOS	BOS	BOSTON,MASS.	Y	HERRING GULL	14N14	4
06/19/90	274	A320	CFM56	5	1	N	0	V1+	N	TR	PAU-ORY	PAU	PAUK,BURMA	N			
06/19/90	315	A300	CF6	80C2	1	N	0	V1+	N	TR	BOM-DXB	BOM	BOMBAY,INDIA	N	BLACK KITE	3K20	
06/20/90	246	B747	4000	4158	1	N	0	TAXI	N		SEL-CDG	XFO	SEOUL OR PARIS-CDG	N			
06/20/90	288	B767	CF6	80A	2	N			N		-KMJ	XFO	KUMAMOTO,JAPAN??	N			
06/22/90	289	B767	CF6	80A	2	N			N		-NGS	XFO	NAGASAKI,JAPAN ??	N			
06/25/90	290	B767	CF6	80A	2	N			N		-OSA	XFO	OSAKA,JAPAN ??	N			
06/26/90	291	B767	CF6	80A	1	N			N		-OSA	XXX	OSAKA,JAPAN ??	U			
06/27/90	241	B747	JT9D	70	3	N	0	VR	DIV	TR	LXS-ATH	LXS	LEMNOS,GREECE	N	HERRING GULL	14N14	
06/29/90	240	B767	JT9D	7R4E	2	N	400		ATB	CL	WLG-MEL	WLG	WELLINGTON,NEW ZEALAND	N	RED-BILLED GULL	14N?	
06/29/90	275	A320	CFM56	5	1	N	0	V1-	N	TR	FRA-	FRA	FRANKFURT,GERMANY	N			
07/01/90	344	A320	CFM56	5	2	N			N	AP	-LHR	LHR	LONDON-LHR,ENGLAND,UK	N			
07/02/90	242	B767	4000	4060	1	N			N	AP	EWR-CPH	CPH	COPENHAGEN,DENMARK	N	EURASIAN KESTREL	5K27	
07/02/90	322	A300	4000	4158		N			N		YUL-ORY	XFO	MONTREAL OR PARIS	N	CHIMNEY SWIFT	1U33	
07/05/90	337	B757	RB211	535E4	2	N			N			XUS	TULSA,OKLAHOMA ??	Y			
07/05/90	369	A310	CF6	80C2	1	N	400		N	AP	-TLS	TLS	TOULOUSE,FRANCE	N	"SMALL BIRD"		
07/06/90	339	B757	RB211	535C	2	N	0	120	ATB	TR	LHR-	LHR	LONDON-LHR,ENGLAND,UK	N			
07/12/90	254	B767	4000	4060	1	N					CPH-CPH	CPH	COPENHAGEN,DENMARK	N			
07/13/90	370	B767	CF6	80C2	2	N	0		N	TX	TYO-	TYO	TOKYO-TYO,JAPAN	N			
07/14/90	371	A300	CF6	80C2	2	N			N		-BGI	XFO	BARBADOS??	N			
07/14/90	372	A310	CF6	80C2	2	N			N	CL	CFU-HUC	CFU	CORFU,GREECE	N	EGYPTIAN VULTURE	3K43	
07/15/90	338	B757	RB211	535E4	2	N			N		AMS-YYZ	XFO	AMSTERDAM OR TORONTO	N	KILLDEER	5R33	
07/16/90	345	A320	CFM56	5	2	N			N		-DUS	XFO	DUSSELDORF,GERMANY??	N			
07/17/90	252	A300	JT9D	7R4H	2	N	0		N	TR	RUH-ABT	RUH	RIYADH,SAUDI ARABIA	N		FBI	
07/17/90	373	B767	CF6	80C2	1	N			N		-TYO	XFO	TOKYO-TYO,JAPAN??	N			
07/18/90	355	A310	CF6	80A	2	N			N	AP	-NCE	NCE	NICE,FRANCE	N	"SEAGULL"		
07/22/90	255	B767	JT9D	7R4E	1	N			ATB	CL	PER-NRT	PER	PERTH,AUSTRALIA	N	BANDED PLOVER	5N23	
07/23/90	253	B767	JT9D	7R4E	2	N			N			XFO	ETHIOPIA??	N			
07/24/90	321	DC10	JT9D	59A	1	N			N	TC	NGO-FUK	NGO	NAGOYA,JAPAN	N			
07/24/90	356	A310	CF6	80A	2	N			N		AMS-LCA	XFO	AMSTERDAM OR LARNACA	N	COMMON ROCK DOVE	2P1	
07/24/90	374	B767	CF6	80C2	1	N			N		-OSA	XFO	OSAKA,JAPAN??	N			
07/24/90	375	B767	CF6	80C2	2	N			N		-MYJ	XFO	MATSUYAMA,JAPAN??	N			
07/25/90	320	B767	JT9D	7R4D	1	N			N	LA	-FUK	FUK	FUKUOKA,JAPAN	N			
07/27/90	256	B767	JT9D	7R4D	2	N			N		-HND	XFO	TOKYO-HND,JAPAN ??	N			
07/27/90	319	DC10	JT9D	59A	1	N			N		OKI-HND	XFO	OKI ISLAND/TOKYO-HND,JAPAN	N			
07/28/90	262	A310	4000	4152	2	N				CL	KHI-	KHI	KARACHI,PAKISTAN	N			
07/28/90	316	DC10	JT9D	59A	1	N			N		OSA-PUS	XFO	OSAKA,JAPAN/PUSAN,KOREA	N			
07/28/90	346	A320	CFM56	5	1	N	0		N	LR	-YUL	YUL	MONTREAL,CANADA	N	RING-BILLED GULL	14N12	
07/28/90	357	B767	CF6	80A	1	N			N		-KOJ	XFO	KAGOSHIMA,JAPAN???	N			
07/29/90	358	B767	CF6	80A	2	N			N		-KMI	XFO	MIYAZAKI,JAPAN??	N			
07/30/90	257	B757	2000	2037	2	TRVS FRAC	800		ATB	CL	LAX-SLC	LAX	LOS ANGELES,CAL.	Y	WESTERN GULL	14N[illegible]	
07/30/90	376	A300	CF6	80C2	1	N			N		-BKK	XFO	BANGKOK,THAILAND??	N			
07/31/90	377	A310	CF6	80C2	1	N	0		N	LR	-DEL	DEL	DELHI,INDIA	N			
08/01/90	260	B757	2000	2037	1	N			N		-DTW	XUS	DETROIT,MICHIGAN??	Y	AMERICAN ROBIN	412314	
08/01/90	261	B757	2000	2040	2	N					ABY-MOB	XUS	ALBANY,GA OR MOBILE,ALA	Y	AMERICAN MOURNING DOVE	2P105	
08/04/90	359	B767	CF6	80A	2	N	0		N	LR	-KCZ	KCZ	KOCHI,JAPAN	N			
08/05/90	263	B747	JT9D	79	4	N	0		ATO	TR	JFK-	JFK	NEW YORK-JFK,NY	Y	HERRING GULL	14N14	
08/05/90	316	B767	4000	4060	1	N	500		ATP	U	AMS-MEX	AMS	AMSTERDAM,NETHERLANDS	N			
08/06/90	347	A320	CFM56	5	1	N	0	V1+	DIV	TR	LIL-LYN	LIL	LILLE,FRANCE	N			
08/06/90	324	A300	4000	4158	1	N			N		JIB-ORY	XFO	DJIBOUTI OR PARIS	N	DON SMITH'S NIGHTJAR	5U55	
08/10/90	317	A300	4000	4158	1	N			ATB	TC	SEL-PUS	SEL	SEOUL,KOREA	N	CHIMNEY SWIFT	1U33	
08/10/90	378	A310	CF6	80C2	1	N			N		-BOM	XFO	BOMBAY,INDIA??	N			
08/11/90	326	A300	4000	4158	1	U					-SEL	XFO	SEOUL,KOREA??	N			
08/12/90	325	B767	4000	4060	1	N			N	AP	-AMS	AMS	AMSTERDAM,NETHERLANDS	N			
08/13/90	379	B767	CF6	80C2	1	N			N		ORY-ALG	XFO	PARIS-ORY OR ALGIERS	N			
08/13/90	348	A320	CFM56	5	1	N	0	V1+	N	TR	BRE-	BRE	BREMEN,GERMANY	N			
08/14/90	323	B757	2000	2037	1	MEMB	10	VR+	N	TO	JFK-SLC	JFK	NEW YORK-JFK,NY	Y	RING-NECKED PHEASANT	4L161	
08/14/90	323	B757	2000	2037	2	MEMB	10	VR+	N	TO	JFK-SLC	JFK	NEW YORK-JFK,NY	Y	RING-NECKED PHEASANT	4L161	
08/15/90	360	B767	CF6	80A	2	N	0		N	LR	-OKJ	OKJ	OKAYAMA,JAPAN	N			
08/16/90	380	A310	CF6	80C2	2	N	0		N	LR	-NTE	NTE	NANTES,FRANCE	N			
08/20/90	349	A320	CFM56	5	1	N			N		-LYN	XFO	LYON,FRANCE??	N			

BIRDNAME	SPEC	#BDS	WT	PWRLOSS	VIBE	IFSD	ABCDE	FGHIJ	KLMNO	PQ	NHS	REMARKS	EVT#
HERRING GULL	14N14	4-5	32	N	N	N					0	3 BDS HIT FAN, 1-2 DOWN CORE	214
		1		N		N					0	ODOR ALL ENG PARAMS NORMAL	274
BLACK KITE	3K28	1	20	N	3.0	N	YY			Y	1	3 FB BE, 5 OGV'S SPLIT TRAILING EDGE	315
		1		N		N					0	WALKAROUND..RESH REMNS FB'S & EXIT VANES	246
		1		N		N					0	GRD INSP	288
		1		N		N					0	BIRD HIT FAN BOOSTER IGV 6:00 POSITION	289
		1		N		N					0	GRD INSP.	290
		1		N		N					0	GRD INSP	291
HERRING GULL	14N14	1	40		HIGH	VIBES	Y	YY Y			2	COWL PEN. 4FB BE,1 BROKEN,PIECE HIT#4 ENG	241
? BILLED GULL	14N7	1	11		HIGH	N	Y ?				1	? BL BE. VOL POWER RED.	240
		1		N		N					0	ODOR IN CABIN STAINS ON FAN & CORE	275
		1		N		N					0	MARK ON AIRFRAME.ENG.INGESTION?	344
EURASIAN KESTREL	5K27	1	8								0	RMNS ON FAN EXIT VANE	242
?NEY SWIFT	1U33	1	2								1	1 FB BE.LNGPOS?	322
		1		N	N	N	YY				1	2 FB LE CURL	337
"SMALL BIRD"		1		N		N					0		369
		1		N	4.0	N	Y Y				1	3 FB BE. 2 FB SHGLD."PIGEONS OR GULLS"	339
		1									0	HIT LPC INLET,FAN EXIT VANES.TRNG FLITE	254
		1		N	3.2	N	Y		Y	Y	2	IMPCBLLE TIP MSNG.MDSPN SHRD OVLAP.REMVD	370
		1		N		N	YYY			Y	1	1FB BE,CRACKED, NOTCHED 1FB LE NICKED	371
EGYPTIAN VULTURE	3G43	1	?5	N		N	Y	Y	Y		2	4 FB LE BE.2 HPC BL DMGD.ENG RMVD.	372
?LLDEER	5N39	1	?	N	N	N					0	DEBRIS ON OGV'S. WALKAROUND.	338
		1		N		N					0	DEBRIS ON FB'S & 1ST STG LPC.	345
	TBI				INL			Y Y			2	4 FB BE, 1 BRK OUT	252
		1		N		N					0	GRD INSPECT. AT IYO	373
"SEAGULL"		1		N		N	?				1	3 FB SHINGLED	355
?ODED PLOVER	5N23	1	7				Y	Y			2	1 FB LE BRKN, 2 FB BE. HIGH VIBES ON LDG	255
		1									1	1 FB BE	?53
		1									0	SHELL.INTO CORE. DAMAGE???	321
COMMON ROCK DOVE	2P1	1	14	N		N					0	DEBRIS IN CORE	358
		1		N		N					0	GRD. INSP. AT OSAKA	374
		1		N		N					0	GRD INSP AT MATSUYAMA	375
		1									0		320
		1		N		N					0	DISCOVERED UPON ENGINE REMOVAL	256
		1									0		319
							Y			Y	1	DAMAGED-? #BDS???	262
		1									0		318
?G BILLED GULL	14N12	1	17	N		N	Y				1	1FB DMGD. DEBRIS IN OGV'S	346
		1		N		N					0	BIRD INTO CORE.	357
		1		N		N					0	GRD. INSP. AT MIYAZAKI	359
?LERN GULL	14N13	1	40.4	50%	HIGH	VIBES	Y	YY Y	Y Y		2	CONTND TRUS FRACT 3FB.INVSTGD.COWL HOLES	257
		1		N	HIGH	N		Y	Y		2	2 HPC BL TIPS MSNG,? W/LE TIP CURL.REMVD	376
		1		N		N			Y		2	OLD HPC BL DMG NOT BY BIRDSTRIKE.3 OR 0?	377
AFRICAN ROBIN	412314	1	2.5				Y			Y	1	UNCONFIRMED. 3 FB DMG BEYOND LIMITS	260
AFRICAN MOURNING DOVE	2P105	1	4				YY				2	CRACK F BLADE	261
		1		N		N					0		353
HERRING GULL	14N14	1	40						Y		2	INTO CORE.SURGE, HI EGT.DAMAGE??	263
		1									2	4 FB BE	316
		1		N	5.0	N	Y		Y		2	HPC STG 5&9 DMG.ENG CHANGED.DIV TO ORLY	347
? SMITH'S NIGHTJAR	5155		1.25								0	WALK AROUND. # BIRDS?	324
?NEY SWIFT	1U33	1	1			NOT BIRD			Y		0	5 FRACT HPT BLDS,IFSD-NOT DUE TO BIRDS.	317
		1		N		N		Y		Y	1	GRD INSP AT BOMBAY.OGV DMG	378
										Y	2	REMOVED DAMAGE??? #BIRDS??	326
											0	WALK AROUND.#BIRDS??	325
		1		N		N					0	DEBRIS ON SPINNER AND FB'S	379
		1		N	Y	N					0	HI VIBE. FLUCTUATED.ODOR IN CABIN.	348
RING NECKED PHEASANT	4L161	>1	40					Y			2	SHELL.1 FB BKN.INTO CORE?	323
RING NECKED PHEASANT	4L161	?	40				Y				1	3 FB BE INTO CORE?(SHELL).	323
		1		N		N					0		360
		1		N		N					0		380
		1		N		N					0	GRD INSPECTION AT LYON	349

DATE	EVT#	A/C	ENG	DASH	POS	SIGEVT	ALT	SPD	CREW	POF	CITYPRS	APT	LOCALE	US	BIRDNAME	SPEC
08/20/90	350	A320	CFM56	5	1	N	0		N	LR	-DUS	DUS	DUSSELDORF,GERMANY	N		
08/21/90	361	A310	CF6	80A	1	N	0		N	LR	-IST	IST	ISTANBUL,TURKEY	N	"LGE SEAGULL"	
08/22/90	351	A320	CFM56	5	2	N	0	V1+	N	TR	ORY-TLS	ORY	PARIS-ORLY,FRANCE	N		
08/24/90	362	B767	CF6	80A	1	N	0		N	LR	-SDJ	SDJ	SENDAI,JAPAN	N		
08/25/90	352	A320	CFM56	5	1	N			N		-YUL	XFO	MONTREAL,CANADA???	N		
08/28/90	363	B767	CF6	80A	2	N	0		N	LR	-TAK	TAK	TAKAMATSU,JAPAN	N		
08/29/90	327	B747	JT9D	7R4G2	4	N			N	AP	-FRA	FRA	FRANKFURT,GERMANY	N		
08/31/90	301	B747	CF6	80C2	3	N	0	100	N	LR	-AMS	AMS	AMSTERDAM,NETHERLANDS	N		
09/04/90	353	A320	CFM56	5	2	N	0		N	LR	-CDG	CDG	PARIS-CDG,FRANCE	N		
09/04/90	382	B747	CF6	80C2	1	MEMB	0	120	N	LR	-AMS	AMS	AMSTERDAM,NETHERLANDS	N	BLACK-HEADED GULL	14N36
09/04/90	382	B747	CF6	80C2	2	MEMB	0	120	N	LR	-AMS	AMS	AMSTERDAM,NETHERLANDS	N	BLACK-HEADED GULL	14N36
09/04/90	383	A310	CF6	80C2	2	N	0		N	LR	YYZ-YVR	YVR	VANCOUVER, CANADA	N	GLAUCOUS-WINGED GULL	14N22
09/05/90	364	A310	CF6	80A	1	N			N	AP	-IST	IST	ISTANBUL,TURKEY	N	HERRING GULL	14N14
09/05/90	365	A310	CF6	80A	2	N			DIV	CL	IST-DXB	IST	ISTANBUL,TURKEY	N		
09/06/90	340	B757	RB211	535C	1	N			N	DE	LHR-AMS	AMS	AMSTERDAM,NETHERLANDS	N		
09/08/90	304	B767	CF6	80C2	1	N			N		-KOJ	XFO	KAGOSHIMA,JAPAN??	N		
09/10/90	354	A320	CFM56	5	1	N			N		-DTW	XUS	DETROIT,MICHIGAN??	Y		
09/10/90	305	B767	CF6	80C2	1	N			N		-TYO	XFO	TOYAMA,JAPAN??	N		
09/10/90	306	B767	CF6	80C2	2	N	0	V1+	N	TR	YYZ-YUL	YYZ	TORONTO,CANADA	N		
09/11/90	307	A310	CF6	80C2	2	N	0	V1+	ATB	TR	MBA-	MBA	MOMBASA,KENYA	N		TBI
09/13/90	388	B767	CF6	80C2	1	N			N		-CTS	XFO	SAPPORO-CHITOSE,JAPAN??	N		
09/17/90	366	B767	CF6	80A	2	N	0		N	LR	-OKJ	OKJ	OKAYAMA,JAPAN	N		
05/17/90	389	B767	CF6	80C2	2	N	10		N	LD	-WAW	WAW	WARSAW,POLAND	N	BLACK-HEADED GULL	14N36
09/18/90	311	B747	RB211	524G	2	N			N		PAE-PAE	PAE	EVERETT,WASHINGTON	Y		
09/18/90	342	B757	RB211	535C	2	N	0		N	LR	LHR-GVA	GVA	GENEVA,SWITZERLAND	N		
09/18/90	367	B767	CF6	80A	2	N			N		-OSA	XFO	OSAKA, JAPAN??	N		
09/18/90	390	B767	CF6	80C2	2	N			N		-AUH	XFO	ABU DHABI,U.A.E.??	N		
09/19/90	391	A310	CF6	80C2	2	N			N		-MUC	XFO	MUNICH,GERMANY??	N		
09/23/90	343	B747	RB211	524G	4	N			N	TO	SYD-MEL	SYD	SYDNEY,AUSTRALIA	N		
09/24/90	368	A310	CF6	80A	2	N	0	V1+	N	TR	BRE-FRA	BRE	BREMEN,GERMANY	N	"SEAGULL"	TBI
09/30/90	392	B767	CF6	80C2	1	N	0		N	LR	-OIT	OIT	OITA,JAPAN	N		

[illegible]S	BIRDNAME	SPEC	#BDS	WT	POWLOSS	VIBE	IFSD	ABCDE	FGHIJ	KLMNO	PQ	NMS	REMARKS	EVT#
[illegible]			1		N		N					0		350
[illegible]	"LGE SEAGULL"		1		N	3.5	N	YY Y				1	1 FB LE BE, 2 FB SHGLD	361
N			1		N		N	Y				1	2 FB BE	351
[illegible]			1		N		N					0		362
N			1		N		N			Y		2	STG1BL CRACK,2BL PIECE MISSING.NO FB DMG	352
[illegible]			1		N		N	Y				1	1 FB BE - TRIMMED	363
[illegible]												0	# BIRDS ??	327
N			1		N		N	Y				1	2 FB DISTORTED, RPLCD.	381
N			1		N		N					0		353
N	BLACK-HEADED GULL	14N36	2	10	N		N					0		302
N	BLACK-HEADED GULL	14N36	2	10	N		N					0		302
N	GLAUCOUS-WINGED GULL	14N22	1	40	N		N	Y				1	2 FB SHINGLED--WERE UNSHGLD	383
N	HERRING GULL	14N14	1	40	N	3.5	N	Y			Y	1	FINL AP.2FB MIDSPN SHRD LCKUP,MINOR SHGL	364
N			1		N	7.5	N	YYY				1	3 FB TIP CURL. 1 FB TURN	365
N			1		N	N	N					0		340
[illegible]			1		N		N					0	WALKAROUND	384
[illegible]			1		N		N					0	GRD.INSP AT DETROIT	354
N			1		N		N			V		2	MAT.MISSING FR LE HPC 2 PLACES.ENG REMVD	385
N			1		N	INC	N					0	NO CREWACT?	386
N		UBI	1		N	HIGH	N	Y Y				1	2 FB LE DISTORTION & SHINGLED.	387
N			1		N		N	Y				1	2 FB SHINGLED-LATER REPLACED	388
N			1		N		N					0		366
N	BLACK-HEADED GULL	14N36	1	10	N		N					0	50-100 BIRD FLOCK.S HIT A/C	389
					N	N	N					0	MAIDEN FLITE	341
					N	N	N					0	DEBRIS DOWN BYPASS DUCT	342
			1		N		N					0		367
			1		N		N					0	GRD INSPECT.	390
			1		N		N					0	GRD. INSPECT	391
			1		N	N	N	Y				1	IDG INTAKE CONTAMINATED	343
	"SEAGULL"	UBI	1		N	6.0	N	Y	Y	Y		2	10 FB DMGD, 2 HPC BLS TIP MISSING	368
			1		N		N		Y		Y	2	5FB,2UGV,BLOCKER DOOR DMGD.THRUST RVERSL	392